Self-Study Report for
Electrical Engineering

Kettering University Mission Statement

Serve society by preparing future leaders for a global workplace through undergraduate cooperative education, graduate education and research in engineering, science and management

Department of Electrical and Computer Engineering Mission Statement

The mission of the Department of Electrical and Computer Engineering is to serve society by preparing undergraduate and graduate students for professional practice as electrical or computer engineers, by providing continuing education opportunities for practicing engineers, and by making original contributions to the art of engineering.

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with

Appendix I – Additional Program Information

submitted to

Engineering Accreditation Commission
Accreditation Board for Engineering and Technology

A. BACKGROUND INFORMATION

1. Degree Titles

This self-study is for the degree program "Bachelor of Science in Electrical Engineering" offered by the Department of Electrical and Computer Engineering. The department also offers the degree program "Bachelor of Science in Computer Engineering" and has prepared a separate self-study for the computer engineering degree. Because these two programs are administered within the same department, they share some common resources, program requirements, and department policies. This self-study occasionally refers to the computer engineering program.

2. Program Modes

All programs at Kettering University, including the Electrical Engineering program are compulsory cooperative education programs: the cooperative work experience is a degree requirement. Students alternate eleven-week on-campus academic terms with twelve-week co-op work terms. Courses are normally scheduled in the daytime and are intended for on-campus resident students. Occasionally some sections of multi-section courses are scheduled in the evening. Many instructors provide course materials on course web sites, but these are intended to supplement an on-campus offering of the course rather than to facilitate distance education. The university does have significant distance education capabilities, such as offering courses on videotape and by streaming video over the internet. These capabilities are used only for graduate courses and continuing education courses.

3. Actions to Correct Previous Shortcomings

There were no concerns, weaknesses, or deficiencies noted in the final statement associated with the most recent ABET accreditation action.

4. Contact Information

The primary pre-visit contact person is Dr. Mark Wicks, Head of the Department of Electrical and Computer Engineering. Program evaluators may also contact Dr. Ravi Warrier. Their contact information follows:

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B. ACCREDITATION SUMMARY

1. Students

The institution uses several methods to evaluate, advise, and monitor students. Evaluation, advisement, and monitoring are each discussed separately in the following paragraphs:

Evaluation:

At the course level, the instructor evaluates students and assigns a grade to each student. At a higher level, the electrical engineering program evaluates its students using the assessment process discussed in detail later in this report in Section 3. The program uses a variety of assessment tools. These tools include

- Scores on common (across all sections and instructors) portions of final exams.
- Evaluation of student work by a program assessment committee in the senior design experience course.
- Evaluation of each student's final thesis project by the faculty advisor and by the employer advisor.
- Evaluations of each student's work term experience by the co-op employer.

A complete list of the tools and additional evaluation methods appears in Section 3.

Advisement:

Faculty in the Department of Electrical and Computer Engineering, staff in the Academic Services Department, and staff in the university's Wellness Center participate in student advisement. The department head and the program director also serve as advisors, particularly when problems arise that cannot be handled by the faculty advisor.

A meeting with an electrical engineering program faculty advisor is required at the following times:

- Prior to registering for classes each term
- When a student wants to drop a class
- On initiation of the Senior Thesis Project
- When planning a study-abroad term
- When changing majors

Department faculty members advise students on course selection each term. Advisement on course selection is particularly important for students who have strayed from the representative program that is published in the Kettering University Catalogue of Undergraduate Baccalaureate Programs. The department provides supplemental information for both the faculty members and the students to help advise students on how to complete their coursework. Representative programs are provided for typical students, students who are ahead, and for students who are behind. These handouts are disseminated to the ECE students on a Web site implemented using the Blackboard software package. When a student drops a class, the faculty advisor advises the student on the ramifications of dropping the class in terms of time to graduation and any other issues that may arise such as maintaining full time student status.

Each student is assigned a faculty advisor on initiation of the thesis project. The faculty advisor works with the student through the completion of the thesis to ensure timely completion of a satisfactory thesis project. The student typically submits a work plan or "plan of attack" to the faculty thesis advisor.

Finally, each study abroad program at foreign institutions has a faculty advisor specifically devoted to that program. That faculty advisor is familiar with issues unique to that particular foreign institution and can advise students accordingly.

The Academic Services Department monitors the performance of all students (as measured by grades and number of credit hours earned) and intervenes whenever students fail to remain in good academic standing. Good academic standing is defined in the catalog as completion of 12 credit hours in a term, maintaining a cumulative GPA of 80, and achieving a term GPA of 80. Students who are not in good standing must participate in academic advising through the Academic Services Department. The process is described more fully in the Kettering University Catalog of Undergraduate Baccalaureate Programs. Also, a faculty member may refer a student to the Academic Services Department or to the Wellness Center if he/she feels the student's needs are better served by one of those offices.

Monitoring:

Students are monitored by the Department of Electrical and Computer Engineering, by the Academic Services Department, by the Thesis Office, by the Registrar, and by the Cooperative Education Office. The Department of Electrical and Computer Engineering monitors the progress of the students toward the completion of the coursework needed to satisfy their degree requirements. Every term, the department prepares an advising checklist that shows which courses a student has completed and which courses remain to complete degree requirements. These checklists are provided to the faculty member who advises the student during the course selection process each term. Prior to registering for the final academic term (i.e., the term in which the student expects to complete all degree coursework requirements), the student and the student's faculty advisor complete a final academic term course selection and course work audit form. Normally either the department head or the electrical engineering program director advises the student during the final academic term. The Academic Services Department monitors the progress of students toward completion of the coursework portion of their degree requirements and intervenes as necessary. This process is described in the "Advisement" section above.

The Cooperative Education Office assumes primary responsibility for monitoring the work experience portion of the degree requirements. After completion of each work term, the employer completes a student evaluation. The co-op office monitors these work-term evaluations. The co-op office also monitors students to ensure that they have jobs and that they are making progress on the non-academic portion of their degree requirement. The co-op office monitors unemployed students and helps them to secure employment.

The Department of Electrical and Computer Engineering, the Thesis Office, and the Registrar jointly monitor students during the Senior Thesis Project component of their degrees. The Senior Thesis Project is completed primarily during the students' co-op work terms. To initiate the Senior Thesis Project, students are required to submit a thesis proposal to the Thesis Office. The Thesis Office records it and passes it to the degree department for review. The degree department assigns a faculty member to review the proposal and, if the proposal is accepted, to serve as the advisor for the thesis. The thesis proposal is one of several required milestones in the Senior Thesis Project. Other milestones include an initial meeting with the faculty advisor, a joint meeting with the faculty advisor and the work advisor, and submission of a preliminary (draft) thesis. The milestones are recorded by the degree department and are jointly monitored by the degree department, the Thesis Office, and the Registrar.

Transfer Credits:

Kettering University welcomes students who transfer from other colleges. Transfer credits are evaluated and awarded on a course-by-course basis by faculty of the appropriate discipline. Articulation agreements have been established with over thirty community colleges and other colleges across the country to aid students in planning and preparing for transfer to Kettering University and to optimize transfer credit. Students may take up to two years of coursework at these schools and may transfer to Kettering University at any time during the process.

Transfer students are expected to present an overall 3.0 grade point average. A separate grade point average is calculated for English, mathematics, and science courses and students are expected to achieve an overall 3.0 grade point average in these courses. Admission decisions for students who have completed at least 30 credit hours at another institution in coursework that includes mathematics and sciences will be made on the basis of the college record. Students who have not completed at least 30 credits or students who have no record of mathematics and science courses are evaluated on the basis of their high school records, college records, and test scores. Transfer students must present the same minimum preparation in mathematics and sciences as freshmen candidates. Required coursework may be taken in either high school or college.

Students who have matriculated at Kettering University may complete no more than two courses at another university. These two courses are over and above any transfer credit completed before entering Kettering University and any transfer credit earned as part of an approved study abroad program. Courses taken at other universities by matriculated Kettering University students are evaluated by a similar process used to evaluate courses for transfer students. When a student chooses to complete a course at another university and transfer the credit back to Kettering University, that student completes an application requesting the approval of the course for "transfer credit." A faculty member in the appropriate discipline reviews the course based on a catalog description and whatever additional information the faculty member requests. For the credit to be accepted by Kettering University, the student must receive a grade of 'C' or better. Additionally, the Department of Electrical and Computer Engineering requires that electrical or computer engineering courses completed at another institution must be offered as part of an ABET accredited electrical or computer engineering program at that institution. The department also has a policy of not allowing the senior design project to be completed at another university.

The Academic Services Department maintains statistics on the performance of transfer students and has found that the cumulative GPA of transfer students in their Kettering University courses is actually very slightly higher than the GPA of students who began their academic career at Kettering University. The excellent performance of transfer students provides evidence that the transfer credit policies are working.

An entirely different process is used for transfer credit for study abroad programs. Study abroad programs are not subject to the two course limit on transfer credit and do not prevent a student from subsequently taking two courses at another institution. Due to significant differences in foreign institutions, each study abroad program is unique. Approval of a study abroad program requires approval of a document that explains the selection of courses available for transfer credit at the foreign institution, the performance standards required to receive transfer credit, and the process to be used to evaluate the effectiveness of the program. Each study abroad proposal must be approved by the Electrical Engineering Curriculum Committee, by the Head of the Department of Electrical and Computer Engineering, by the International Programs Committee, and by the Faculty Senate. Study abroad programs currently available to electrical and computer engineering students require that a portfolio of all work (assignments, projects, and exams) at foreign institutions be submitted to Kettering University for assessment by the same standards that would be used if comparable courses were taken at Kettering University. Again, the senior design project must be completed at Kettering University.

2. Program Educational Objectives

The electrical engineering program is designed to provide its graduates a solid educational foundation on which they can build successful and sustainable careers in electrical engineering or a related field. As a working definition of program educational objectives, we adopt the notion that program educational objectives are the desired attributes or achievements of graduates a few years after leaving Kettering University. The electrical engineering program educational objectives are:

1. An ability to analyze and design basic electrical, electronic and digital systems.
2. The necessary interpersonal and communication skills to be productive members in a team work environment.
3. An insight into contemporary issues and their implications to engineering practice.
4. The skills, confidence and experience to enable them to assume positions of technical and/or managerial leadership in their career paths.
5. An awareness of ethical and professional responsibilities.
6. A strong background and motivation to pursue life-long learning.

Dissemination:

The above listed educational objectives are published annually in the Kettering University Catalog of Undergraduate Baccalaureate Programs and in all printed literature about the program distributed by the department. They also appear in the program "fact sheets" that can be downloaded from the "Academics" area of the department web site at

`http://ece.kettering.edu`

Consistency:

These educational objectives are consistent with both the mission of the university and the EAC accreditation criteria. Kettering University's mission is to

"Serve society by preparing future leaders for a global workplace through undergraduate cooperative education, graduate education and research in engineering, science and management."

The mission of the Department of Electrical and Computer Engineering is

"…to serve society by preparing undergraduate and graduate students for professional practice as electrical or computer engineers, by providing continuing education opportunities for practicing engineers, and by making original contributions to the art of engineering."

To be consistent with these two missions, the electrical engineering program must prepare students for professional practice as electrical engineers and prepare students to be future leaders for a global workplace through undergraduate cooperative education. Program Educational Objective 1 is fundamental for professional practice as an electrical engineer. Program

Educational Objectives 2, 3, 5, and 6 are recognized by employers as desirable qualities for a practicing engineer. Finally, Program Educational Objective 4 reflects the university's mission of preparing future leaders.

Constituencies:

The principal constituencies of the electrical engineering program are

- Students
- Industry
- Co-op employers
- Alumni

The department has an Industrial Advisory Board that meets once a year and serves as a vehicle for obtaining input from industry, co-op employers, and alumni. The composition of the Industrial Advisory Board broadly represents these three groups.

In the past, input from students has been obtained from both focus group meetings and responses to paper student opinion surveys. Very recently, in early 2003, a more formally organized Student Advisory Board was formed to facilitate communication with department faculty and to provide a forum for issues important to the students. The Student Advisory Board will meet regularly once each term. We have also created an open forum bulletin board for student feedback using the Blackboard software. Full use of this software is relatively new to the university and we are only beginning to realize its full potential. All students belong to an electronic "Blackboard Community" which facilitates communication with the students. The Blackboard software is an electronic communication medium that facilitates dissemination of information, open discussion, and surveys. The department has been using this software to disseminate information to the students since early 2002, and is now using it as a mechanism to obtain feedback from the students. The Blackboard software allows us to survey the students electronically on a continual basis. It also archives survey results and tallies the results. This allows us to solicit feedback quickly, accurately, and inexpensively.

In the past, input from alumni has been obtained from members of the Industry Advisory Board, several of whom are alumni, and from a university administered annual Alumni Survey. Very recently, the department created a separate Blackboard Community to which all electrical engineering alumni belong. The community is managed within the department and is very similar to the one provided for the students. Again, the Blackboard Community allows us to solicit feedback quickly, accurately, and inexpensively.

Process to establish initial objectives:

The six program educational objectives evolved during an extensive university-wide curriculum review and reform process that the university conducted from late 1998 to early 2001. Prior to drafting these objectives, the (at that time) Electrical and Computer Engineering Curriculum Committee held an ECE student focus group meeting in November 1998 where perceived deficiencies or inadequacies in the electrical and computer engineering programs were discussed [minutes of this meeting are available on request]. The student feedback at this meeting significantly influenced decisions made during the curriculum reform process. The Electrical Engineering Curriculum Committee proposed an initial version of the six program educational objectives during an extensive curriculum review process during the 1999-2000 academic year. The curriculum committee revised the objectives several times and the department faculty approved them early in 2001. ECE Department's Industry Advisory Board reviewed the program objectives at its December 2001 meeting and recommended several changes. The advisory board significantly influenced the wording of Program Educational Objective 4, for example. Based on the advisory board input, the electrical engineering program faculty established the current version of the objectives early in 2002.

Process to maintain appropriate objectives:

The objectives represent accomplishments of graduates a few years after graduation, so the timeframe for adjustment of the objectives is few years. Indeed, alumni respondents to the university administered alumni survey (of graduates three years out) graduated before the current program objectives had been finalized. Alumni who may have been affected by the current objectives will participate in the survey next year. For these reasons, the established process for maintaining appropriate objectives is to perform a comprehensive review of the appropriateness of the objectives every three years. The current objectives were finalized during the 2001-2002 academic year, the next comprehensive review and revision of the objectives will occur during the 2004-2005 academic year. To obtain information to be used at that time, we are gathering information from several sources. We are currently running an on-line survey entitled "Feedback on educational objectives" in our Blackboard electrical engineering alumni community to gather feedback on our program educational objectives. Alumni have been invited to complete the survey. Each graduate may complete this survey once at any time during any academic year. At the end of each year, we will reset the survey and tabulate the results. The same survey is being run in our Blackboard electrical engineering student community. To obtain additional input from students, the department has formed a student advisory board to provide a forum for students to discuss their needs and concerns with the department. The industrial advisory board will review the objectives again during the 2004-2005 academic year. Preliminary feedback from our on-going Blackboard community surveys appears in Table 2.1.

In summary, the process to revise the objectives is as follows: The electrical engineering program faculty will consider the revision of the Program Educational Objectives every three years, after reviewing the following information:

- Results of Blackboard survey on objectives in the electrical engineering alumni community over past three years
- Results of Blackboard survey on objectives in the electrical engineering student community over past three years
- Comments from Student Advisory Board during the revision year
- Comments from Industrial Advisory Board during the revision year

Any revisions are proposed by the Electrical Engineering Curriculum Committee and brought to the program faculty for their ratification. The next planned review year is the 2004-2005 academic year.

Relationship of objectives to curriculum:

The electrical engineering curriculum is designed to ensure achievement of the objectives. For each objective, the relationship to the curriculum is discussed separately:

An ability to analyze and design basic electrical, electronic, and digital systems. The first two years of the curriculum provide a foundation in basic math and science required to design electrical systems. Students take a sequence of mathematics courses beginning with differential calculus and ending with differential equations. They begin their science sequence with a course in the principles of chemistry. After completing the first calculus course, they complete a sequence of two physics courses beginning with Newtonian mechanics and ending with electromagnetics. After completing the science and math courses, they complete seven required courses in the Department of Electrical and Computer Engineering to provide them with sufficient breadth in electrical, electronic, and digital systems. These seven courses cover the following subject areas: linear circuit analysis (2 courses), digital systems, electronics, microcomputers, electromagnetics, and signals and systems. The remaining electrical engineering courses are electives. To provide depth, students are required to take at least two 400 or 500 level electives; the courses have been numbered so that each 400 level course has at least one 300 level course as a prerequisite. Engineering design is introduced in the Freshman year in MFGG-135, Introduction to Design and Manufacturing. Many of the required electrical and computer engineering courses (such as electronics, microcomputers, and digital systems) have a significant design component. All students are required to complete a significant design project in EE-490, Senior Electrical Engineering Design Project.

The necessary interpersonal and communication skills to be productive members in a team work environment. Students take a series of courses to sharpen their interpersonal and communication skills. As Freshman, all students take COMM-101, Written and Oral Communication I. The course emphasizes presentation of business and technical material. This course is followed by COMM-301, Written and Oral Communication II. COMM-301 has objectives similar to those of COMM-101, but also prepares students to begin their Senior Thesis Project. Team skills and communication skills are reinforced in EE-490, Senior Electrical Engineering Design Project, where students are required to work in teams to complete a significant design project. Students are required to make a presentation of their EE-490 project. Finally, the Senior Thesis Project itself is a significant writing exercise that builds written communication skills. The cooperative work experience is intended to build interpersonal skills and teamwork skills, and feedback suggests that it does; however the work experience will vary depending on where the student works.

An insight into contemporary issues and their implications to engineering practice. An insight into contemporary issues is developed by a strong sequence of liberal studies courses. All students take HS-201, Introduction to Social Sciences and HUM-201 followed by an advanced social science elective. After completing the lower level humanities and social science requirements, all students take LS-480, "Senior Seminar: Leadership, Ethics, and Contemporary Issues." In this course, the methods and perspectives developed in the earlier courses are applied to several case studies. The case studies emphasize leadership, ethics, and contemporary issues. One case study involves a corporate or professional setting.

The skills, confidence and experience to enable them to assume positions of technical and/or managerial leadership in their career paths. The electrical engineering curriculum provides students with technical skills. The cooperative work experience and the Senior Thesis Project builds confidence and experience. A significant lab experience in the curriculum also builds confidence and experience. Students learn leadership through case studies in the course LS-489, "Senior Seminar: Leadership, Ethics, and Contemporary Issues."

An awareness of ethical and professional responsibilities. As discussed above, students learn ethics through case studies in the course LS-480, "Senior Seminar: Leadership, Ethics, and Contemporary Issues." Ethics and professional responsibilities are reinforced in EE-490, "Senior Electrical Engineering Design Project." The cooperative work experience is intended to build an awareness of ethical and professional responsibilities, our feedback suggests that it does; however, the work experience will vary somewhat depending on where each student works.

A strong background and motivation to pursue life-long learning. A strong general education is provided by the technical and general education components of the curriculum. In the Senior

Thesis Project, students undertake a significant individual project that requires self-motivation and independent learning. The thesis project develops those skills necessary for life-long learning.

Evaluation of achievement of the objectives:

Again, our working definition of Program Educational Objectives is the desired attributes or achievements of graduates a few years after leaving Kettering University. To evaluate the objectives, we use the following instruments:

- An annual Alumni Survey of recent graduates
- The Employer Advisor Thesis Evaluation form completed by the employer at the conclusions of the Senior Thesis Project

The Alumni Survey is the principal measurement instrument. The Office of Institutional Research conducts an annual Alumni Survey of those who graduated three years ago. The survey is administered every year in the spring. Table 2.2 shows raw data illustrating the extent to which the objectives are achieved.

As a second measurement instrument, we use the Employer Advisor Thesis Evaluation completed by each student's employer thesis advisor. Every student has a Kettering University faculty advisor and an employer advisor who act as co-advisors on the student's thesis project. Until this year, students normally completed their thesis projects six to nine months after finishing the coursework requirements of their degrees. We value this instrument because it is a direct evaluation of the student by a third party, and does not represent the opinion of either Kettering University or the student. Furthermore, it is an evaluation of each student's on-the-job performance on a real-world project without substantial guidance by Kettering University faculty. For these reasons, we believe it to be a useful gauge of the achievement of our Program Educational Objectives. We also use aspects of this thesis evaluation for the assessment of Program Outcomes as described in Section 3.

Again, we emphasize that the current version of our Program Educational Objectives were finalized after the Alumni Survey respondents graduates and after a significant curriculum revision in 2001 which was tightly coupled to the program objectives. The respondents were, therefore, not directly influenced by either the current objectives or the current curriculum changes. The Alumni Survey feedback will be less speculative in about two years. However, the objectives of the program were not substantially different prior to 2002, and we believe the current Alumni Survey data is informative and establishes a baseline for future respondents.

Conclusions:

Table 2.2 summarizes the results of data collected to date from these two instruments—the Alumni Survey and the Employer Advisor Thesis Evaluation. The Alumni Survey data obviously suffers from having a small number of respondents. However, the Employer Advisor Thesis Evaluation forms represent a reasonable sample size, and convincingly demonstrate that the employers of our students are extremely satisfied with all aspects of our students' work on their thesis projects.

Table 2.1 On-going constituent feedback from on-line community survey.

Program Educational Objectives	**Constituent feedback (in 2003)** The percentage indicates the number who indicated they "agree" or "strongly agree" with the objective	
	Alumni (n=33)	**Current Students** (n=16)
An ability to analyze and design basic electrical, electronic, and digital systems.	97%	94%
The necessary interpersonal and communication skills to be productive members in a team work environment.	100%	88%
An insight into contemporary issues and their implications to engineering practice.	76%	69%
The skills, confidence, and experience to enable them to assume positions of technical and/or managerial leadership in their career paths.	97%	88%
An awareness of ethical and professional responsibilities.	97%	88%
A strong background and motivation to pursue life-long learning.	82%	88%

Table 2.2 Evaluation of achievement of program educational objectives

Objective	Assessment Method	Results		
1. An ability to analyze and design electrical, electronic, and digital systems	**Alumni Survey** Indicate the degree to which your Kettering education increased your knowledge/skills in the following areas:	Percentage indicates those who responded “large increase” or “extremely large increase”		
		2000 (n=16)	**2001** (n=8)	**2002** (n=14)
	Electronics	94%	62.5%	85%
	Solve open-ended problems (school)	53%	57%	71%
	Analyze components processes, or system (school)	56%	25%	92%
	Design components, processes, or systems (school)	67%	75%	62%
	Current engineering practices	63%	37.5%	69%
	Employer Evaluation of Senior Thesis Project Assess the student’s academic preparation and how their co-op work experience contributed to the Senior Thesis Project:	Percentage indicates those who responded “agree” or “strongly agree”		
		2000—2001 and 2001—2002 Combined (n=65)		
	Demonstrated ability to design a system, component or process to meet desired needs	100%		
	Demonstrated ability to identify, formulate, and solve engineering problems	100%		

Table 2.2 Evaluation of achievement of program educational objectives (continued)

Objective	Assessment Method	Results		
2. The necessary interpersonal and communication skills to be productive members in a team work environment.	**Alumni Survey** Indicate the degree to which your Kettering education increased your knowledge/skills in the following areas:	Percentage indicates those who responded "large increase" or "extremely large increase"		
		2000	**2001**	**2002**
		(n=16)	(n=8)	(n=14)
	Written communication skills	25%	25%	83%
	Oral communication skills	31%	75%	85%
	Function on multidisciplinary teams (school)	31%	50%	75%
	Function on multidisciplinary teams (co-op)	50%	75%	%25
	Employer Evaluation of Senior Thesis Project	Percentage indicates those who responded "satisfied" or "very satisfied"		
		2000—2001 and 2001—2002 Combined (n=65)		
	Team Work: Cooperation in working with teams	100%		
	Communication – Oral: Ability to orally convey information and present ideas clearly and concisely.	98%		
	Communication – Written: Quality of student's Senior Thesis Project documentation.	95%		

Table 2.2 Evaluation of achievement of program educational objectives (continued)

Objective	Assessment Method	Results		
3. An insight into contemporary issues and their implications to engineering practice.	**Alumni Survey** Indicate the degree to which your Kettering education increased your knowledge/skills in the following areas:	Percentage indicates those who responded "large increase" or "extremely large increase"		
		2000	**2001**	**2002**
		(n=16)	(n=8)	(n=14)
	Humanities/Social Science	19%	75%	15%
	The history of technical applications	38%	63%	38%
	Contemporary issues	20%	25%	23%
	Current business practices	20%	63%	45%
	The impact of engineering solutions in societal/global context	25%	13%	50%
	Employer Evaluation of Senior Thesis Project Assess the student's academic preparation and how their co-op work experience contributed to the Senior Thesis Project:	Percentage indicates those who responded "agree" or "strongly agree"		
		2000—2001 and 2001—2002 Combined (n=65)		
	Demonstrated the broad education necessary to understand the impact of engineering solutions in a global and societal context.	100%		

Table 2.2 Evaluation of achievement of program educational objectives (continued)

Objective	Assessment Method	Results		
4. The skills, confidence, and experience to enable them to assume positions of technical and/or managerial leadership in their career paths.	**Alumni Survey**	Percentage indicates those who responded "large increase" or "extremely large increase"		
		2000	**2001**	**2002**
		(n=16)	(n=8)	(n=14)
	How satisfied are you with the… co-op experience?	86%	88%	100%
	How satisfied are you with… the decision to be in your field?	94%	63%	92%
	Do you have a leadership position in any community organizations?	13%	Not reported	31%
	Employer Evaluation of Senior Thesis Project	Percentage indicates those who responded "satisfied" or "very satisfied" **2000—2001 and 2001—2002 Combined (n=65)**		
	Knowledge: Application of experience, skills, and knowledge gained during student's co-op work assignments.	100%		

Table 2.2 Evaluation of achievement of program educational objectives (continued)

Objective	Assessment Method	Results
5. An awareness of ethical and professional responsibilities	**Alumni Survey**	Percentage indicates those who responded "large increase" or "extremely large increase"
	Indicate the degree to which your Kettering education increased your awareness of professional/ethical responsibilities	**2000** (n=16) 19% **2001** (n=8) 12.5% **2002** (n=14) 50%
	Employer Evaluation of Senior Thesis Project	Percentage indicates those who responded "satisfied," "very satisfied," "agree," or "strongly agree"
		2000—2001 and 2001—2002 Combined (n=65)
	Accountability: Exercise of Initiative and Responsibility	98%
	Assess the student's academic preparation and how their co-op work experience has contributed to the Senior Thesis Project: Demonstrated understanding of professional and ethical responsibility	98%

Table 2.2 Evaluation of achievement of program educational objectives (continued)

Objective	Assessment Method	Results		
	Alumni Survey	Percentage indicates those who responded "large increase" or "extremely large increase"		
6. A strong background and motivation to pursue life-long learning.		**2000** (n=16)	**2001** (n=8)	**2002** (n=14)
	Completed or working on graduate degree	25%	50%	67%
	Passed the FE exam	13%	Not reported	31%
	Indicate the degree to which your Kettering experienct increased your abilities in the following areas:			
	Engage in life-long learning (school)	20%	63%	67%
	Engage in life-long learning (co-op)	38%	38%	69%
	Employer Evaluation of Senior Thesis Project Assess the student's academic preparation and how their co-op work experience contributed to the Senior Thesis Project:	Percentage indicates those who responded "agree" or "strongly agree" **2000—2001 and 2001—2002 Combined (n=65)**		
	Recognized the need for and demonstrated the ability to engage in life-long learning	100%		

3. Program Outcomes and Assessment

3.1 Program Outcomes and Relationship to EAC and IEEE Guidelines

After adopting the Program Educational Objectives cited in Section 2 of Part B, the faculty of the electrical engineering program established twelve Program Outcomes[1] consistent with the Program Educational Objectives and the guidelines of ABET's Engineering Accreditation Commission (EAC) and the Institute of Electrical and Electronics Engineers (IEEE). These Program Outcomes were designed in such a way that students graduating with the degree of Bachelor of Science in Electrical Engineering must demonstrate:

(a) an ability to solve electrical engineering problems by applying knowledge of such fundamental and advanced mathematics as calculus, differential equations, linear algebra probability and statistics, science, and engineering principles (ABET: a, IEEE)
(b) an ability to design and conduct experiments in electrical engineering, as well as to collect, analyze and interpret data to reach appropriate conclusions (ABET: b)
(c) an ability to design an electrical system, component, or process to meet desired technical, environmental, safety and economical specifications (ABET: c)
(d) an ability to participate and contribute in multi-disciplinary team activities (ABET: d)
(e) an ability to identify, formulate, and solve engineering problems (ABET: e)
(f) an understanding of professional and ethical responsibility and the consequences of failing in it (ABET: f)
(g) an ability to communicate effectively in both oral and written fashion (ABET: g)
(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context (ABET: h)
(i) an appreciation of the need for, and preparedness to engage in life-long learning (ABET: i)
(j) a knowledge of contemporary social, economical and political issues and their impact on the engineering profession (ABET: j)
(k) an ability and experience in using the techniques, skills, and modern engineering tools necessary for engineering practice (ABET: k)
(l) a knowledge of computer science and computer engineering, and engineering sciences necessary to analyze and design systems containing hardware and software components (IEEE)

In the above statements the relationship to the proper guideline (ABET and/or IEEE) is presented in parentheses.

The above Program Outcomes were established by the Curriculum Committee, and then approved by the Faculty of the Electrical Engineering Program in the academic year of 2001-2002.

However, these Program Outcomes were developed through many iterations by the Curriculum Committee over a duration of more than one year. In addition to the input of the electrical engineering faculty, the Industrial Advisory Board and the external team members of a ***mock-accreditation-visit*** held in the Spring of 2002 have also contributed to the development of the

[1] Program Outcomes are the statements that describe what students are expected to know and are able to do by the time of graduation in order to be able to achieve the Program Educational Objectives.

Program Outcomes [Minutes of the IAB meeting and mock visits are available on request]. Furthermore, the academic administration of the university has facilitated many on-campus meetings as well as retreats with the assessment team leaders in order to ensure the development and assessment of Program Outcomes across department boundaries.

3.2 Relationship Between the Program Outcomes and Program Educational Objectives

The Program Outcomes relate to the Program Educational Objectives as shown in Table 3.1. In this table, the symbol "●" indicates a strong relationship between the Program Outcomes and the Program Educational Objectives, whereas the symbol "○" indicates a weaker relationship.

Table 3.1 Relationship matrix between the Program Educational Objectives and the Program Outcomes for the Electrical Engineering Program.

PROGRAM OUTCOMES → PROGRAM EDUCATIONAL OBJECTIVES ↓	a	b	c	d	e	f	g	h	i	j	k	l
1. The ability to analyze and design basic electrical, electronic and digital systems	●	●	●	○	●	●	○	●	○	●	●	●
2. Necessary interpersonal and communication skills to be productive members in a team work environment			○	●	●	●	●	●		●	●	
3. An insight into contemporary issues and their implications to engineering practice				○		○	○	●	●	●		
4. The skills, confidence and experience to enable them to assume positions of technical and/or managerial leadership in their career paths.	●	●	●	●	●	●	●	●	●	●	●	●
5. The awareness of the ethical and professional responsibilities						●	●	●		○		
6. Strong background and motivation to pursue life-long learning	●	●	●	●	●		●	●	●	●	●	●

Table 3.1 was developed carefully by the Curriculum Committee and approved by the Faculty of Electrical Engineering Program as the result of many discussions. According to the matrix shown in Table 3.1, Program Educational Objectives 4 and 6 relate to almost all the Program Outcomes strongly, whereas the remaining Program Educational Objectives relate to some Program Outcomes strongly and to others weakly or not at all.

3.3 Relationship Between the Curriculum and Program Outcomes

The curriculum of the Electrical Engineering Program has been developed in such a way that the Program Outcomes are produced through such components as courses, senior design project, senior thesis project and co-op work assignments.

A matrix has been established for the relationship between the courses in the curriculum of Electrical Engineering Program and the Program Outcomes as shown in Table 3.2. In this table, the letter **"P"** indicates a primary relationship between the Program Outcomes and the respective course, whereas the letter **"S"** indicates a secondary relationship.

Table 3.2 was developed carefully by the curriculum committee and approved by the faculty of Electrical Engineering Program as the result of many discussions and iterations. According to the matrix shown in Table 3.2, a good majority of the courses have primary relationship with the Program Outcomes, while some of the courses have secondary relationship to the Program Outcomes.

As can be seen from Table 3.2, Program Outcomes (a), (b), (c), (e), (k) and (l) can be produced by a variety of Electrical Engineering courses. Moreover, the Assessment Tables of Program Outcomes (Tables 3.3 – 3.14) show that the senior thesis project and the co-op program work also contribute to achieve these outcomes.

Program Outcome (d), on the other hand, is produced by the senior thesis project and the co-op program work. Additionally, some of the EE courses contribute to achieve this Program Outcome as shown in Table 3.2.

Program Outcome (f) is produced primarily by LS-489, Senior Seminar: Leadership, Ethics and Contemporary Issues, the senior thesis project and the co-op program work. Moreover, some of the EE courses contribute to achieve this Program Outcome as shown in Table 3.2.

To produce Program Outcome (g) there are two required courses, COMM-101, Written and Oral Communications I and COMM-301, Written and Oral Communications II offered by the Liberal Studies Department. Also, the senior thesis project and the co-op program work produce this Program Outcome. Furthermore, some of the EE courses contribute to achieve this program outcome as indicated in Table 3.2.

Program Outcome (h), and (i) are produced basically by the senior thesis project and the co-op program work. However, some of the EE courses also contribute to the achievement of these Program Outcomes as presented in Table 3.2.

Program Outcome (j) is produced essentially by courses LS-489, Senior Seminar: Leadership, Ethics and Contemporary Issues; SSCI-201, Introduction to the Social Sciences and an Advanced Social Science Elective. Furthermore, this Program Outcome is produced by the senior thesis project, the co-op program work and some of the EE courses as shown in Table 3.2.

Table 3.2 A matrix that shows the relationship between the electrical engineering courses and the Program Outcomes of the Electrical Engineering Program.

PROGRAM OUTCOMES / COURSES	EE-210/211	EE-230	EE-240	EE-310	EE-320/321	EE-325	EE-330	EE-340	EE-342	EE-344	EE-346	EE-348	EE-420	EE-424	EE-426	EE-428	EE-430	EE-432	EE-444	EE-490	EE-520	EE-530	EE-580	EE-582	EE-584
(a)	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
(b)	P				P		P		P	P	P		P	P	P	P		P		P	P	P	P	S	S
(c)	S			S	P	S	P		P	P	P		P	P	P	P	P	P	P	P	P	P	P	P	P
(d)	S				S		S		S	S	S		S	S	S	P				P	P				
(e)	S	P		P	P		P	P	P	P	P	S	P	P	P	S	P	P	P	P	S	P	P	S	P
(f)	S			S		S	S		S	S	S		S	S		S	S		S	S	S		S	S	S
(g)			S		S		P		P	S	S		S	S	S	S	S	S		P	P	S	S	S	
(h)	S		S		S	S	S	S	P	S	S		S	S	S	S	S		S	P	P	S	S	S	S
(i)	S		P			S	S	S	P	S	S		S	S	S	S	S	S	S	P	P	S	S	S	S
(j)															S				P	P		P			
(k)	P	S	P	S	P	P	P	S	P	P	P	P	P	P	S	P	P	P	P	P	P	P	P	P	P
(l)					P	P	P			S	S		S	S		p			P	P	P	P	P	P	P

3.4 Assessment Process and Tools for the Program Outcomes

In order to ensure that the students achieve the Program Outcomes upon graduation, an assessment process and tools have been established for the Electrical Engineering program.

3.4.1 Assessment Process

With the inception of the new curriculum in the Academic Year of 2001-2002, the assessment of the Program Outcomes is done collectively with the participation of almost all the faculty members in the Electrical Engineering Program under the guidance of the Assessment Team

Leader who oversees the whole assessment process. In this process, the data related to each Program Outcome is analyzed by a faculty member. Then, the assessment results are taken to the Assessment Team Leader for further evaluation. The Assessment Team Leader takes the assessment results to the Curriculum Committee to make the necessary changes for improvement. These changes are further discussed by the Faculty of Electrical Engineering Program at an annual assessment meeting, and finally the implementation of the necessary changes takes place.

3.4.2 Assessment Tools

The collection of data is one of the most important aspects of the Program Outcome assessment. Hence, a set of tools was established within the Electrical Engineering Program in order to assure a set of reasonable and accurate data for assessment. For the assessment of the Program Outcomes, the following tools have been established:

1. Course level assessment in electrical and computer engineering courses
2. Assessment of Senior Design projects
3. Assessment of Senior Theses
4. Assessment of Co-op Work
5. Assessment of the surveys by Educational Bechmarking, Inc. (EBI)
6. Social Science Checksheet
7. Writing Checksheet

Each Program Outcome is assessed based on information obtained from at least three assessment tools.

Course Level Assessment:

As part of the overall evaluation of some courses, especially the basic circuits course, the Electrical Engineering Program has provided common exams to its students since the year 1996 in order to assess their basic knowledge and their ability to apply fundamental concepts. However, the faculty of the electrical engineering program has taken this approach more seriously since the inception of the new curriculum in 2001. Therefore, the faculty of the electrical engineering program has decided to provide common exams as part of the final learning experience in all required electrical engineering courses.

These common exams are developed by the faculty of the electrical engineering program to be consistent with the course learning objectives in order to assess the basic knowledge and skills a student has to attain in that course. The assessment test is given to all the students who are taking the course, usually during the first one-hour of the final exam period, leaving the use of the remaining one hour at the discretion of the course instructor. In general, the assessment test is administered and evaluated by the course coordinators.

The assessment of the respective course is done once every year during the summer term based on the data collected during the previous academic year in order to make any changes, if necessary, for improvement.

Moreover, for some required courses, such as Circuits I and Electronics I, the electrical engineering faculty has felt that an assessment test should be given during the first week of classes in order to assess the knowledge and skills of the students attained from prerequisite courses required for that course. This exam not only provides feedback to the prerequisite courses for improvement, but also helps the instructor tailor teaching the course in a given term.

Standard: Average Grade ≥ 80% is satisfactory.

<u>Assessment of Senior Design Projects:</u>

Senior design projects are evaluated by the Electrical Engineering Senior Design Assessment Committee which is comprised of professors. The form developed by the faculty to assess the projects is filled by the individual committee member in order to assess the student work; there are two components in the assessment: *i*) the over-all rating and *ii*) the item 7 rating, where Item 7 considers each of the following factors in the design: a) Cost, b) Manufacturability, c) Environmental impact and/or sustainability, d) Public health and/or product safety, e) Social and/or political factors, f) Ethical issues. All these items are evaluated on a 5 point scale, 5= excellent, 3=satisfactory, 1= needs improvement.

The assessment of the senior design projects is done once a year during the summer term based on the data collected during the previous academic year in order to make any changes, if necessary, for improvement.

Standard: Rating in the excellent – satisfactory range (≥3).

<u>Assessment of Senior Theses:</u>

Assessment of senior theses is based on the surveys the Thesis Office administers. The surveys were developed with contributions from the faculty, co-op employers and students. These surveys assess how a student's academic preparation and the co-op work experience have contributed to the Senior Thesis Project. Senior Thesis Project of each student is assessed by the faculty advisor, employer advisor and the student.

The assessment of these surveys is done once a year during the summer term based on the data collected during the previous academic year in order to make any changes, if necessary, for improvement.

Standard:

It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or "Strongly agree" to the appropriate questions related to the Program Outcomes as shown in Tables 3.3 – 3.14.

<u>Assessment of Co-op Work:</u>

All the students in the Electrical Engineering Program are enrolled in a unique co-op program in which they alternate terms between university study and the co-op work site. Therefore, co-op work is an integral part of the education of a student in the electrical engineering program. Thus assessment of co-op work is considered as one of the assessment tools, and is based on the surveys administered by the Thesis Office. The surveys were developed with contributions from the faculty, employers and students. The surveys filled out by the students assesses essentially how well the student is academically prepared for the co-op work, while the surveys filled out by the co-op employer not only assess the academic preparation of the student, but also how the student performed during the co-op work term.

The assessment of these surveys is done once a year during the summer term based on the data collected during the previous academic year in order to make any changes, if necessary, for improvement.

Standard:

It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or "Strongly agree" to the appropriate questions related to the Program Outcomes as shown in Tables 3.3 – 3.14.

Assessment of the Surveys by Educational Benchmarking, Inc. (EBI):

Each senior student fills out a survey developed commercially by Educational Benchmarking, Inc. (EBI). The survey results are disseminated to the departments by the Office of Institutional Research once every year. In EBI surveys a 7-point scale, with 7 being "extremely" and 1 being "not at all", has been adopted.

The assessment of these surveys is done once a year during the summer term based on the data collected during the previous academic year in order to make any changes, if necessary, for improvement.

Standard:

A rating in the extremely-moderately range (>4) is considered to be satisfactory.

Social Science Checksheet:

The Department of Liberal Studies has devised a tool in the form of a checksheet in order to assess student knowledge in the area of the social sciences. Students are informed in advance that their performance will be evaluated using this checksheet. The checksheet is evaluated by the faculty in the Department of Liberal Studies and disseminated to the engineering programs. The checksheet scores use a 4-point scale, with 4 being the highest score and 1 being the lowest.

Standard:

A grade > 2 is considered to be satisfactory as recommended by the Liberal Studies Faculty.

Writing Checksheet:

The Department of Liberal Studies has devised a tool in the form of a checksheet in order to assess the student writing. Students are informed in advance that their performance will be evaluated using this checksheet. The checksheet is evaluated by the faculty in the Department of Liberal Studies and disseminated to the engineering programs. The checksheet scores are on a 4-point scale, with 4 being the highest score and 1 being the lowest.

Standard:

A grade > 2 is considered to be satisfactory as recommended by the faculty in the Department of Liberal Studies.

3.5 Achievement of the Program Outcomes

The Program Outcomes have been thoroughly assessed as is evident from the four-column assessment tables shown in Tables 3.3 - 3.14 and the Program Outcome Notebooks[2]. In the following, for each Program Outcome a summary is given to show to what extent the respective outcome has been achieved:

(a) an ability to solve electrical engineering problems by applying knowledge of such fundamental and advanced mathematics as calculus, differential equations, linear algebra, probability and statistics, science, and engineering principles (ABET: a, IEEE)

Based on two assessment tools, as shown in Table 3.3, no actions are required to achieve Program Outcome *(a)*. However, based on the results of assessment exams it is the opinion of the faculty of electrical engineering that actions, presented in Table 3.3, need to be taken to achieve the required standard at course level assessment since all the core courses have a primary relationship to outcome (a). Although outcome (a) appears to be achieved, at the course level the recommended actions should be taken.

(b) an ability to design and conduct experiments in electrical engineering, as well as to collect, analyze and interpret data to reach appropriate conclusions (ABET: b)

Based on three assessment tools shown in Table 3.4, Program Outcome *(b)* has been achieved and no actions are needed.

(c) an ability to design an electrical system, component, or process to meet desired technical, environmental, safety and economical specifications (ABET: c)

This outcome has been achieved based on two assessment tools and requires no action as indicated in Table 3.5. However, according to the third assessment tool (a work evaluation) the standard could not be achieved and further action is necessary as explained in Table 3.5. The corrective action is to administer the assessment tool only after the students have completed their senior design project.

(d) an ability to participate and contribute in multi-disciplinary team activities (ABET: d)

Based on three assessment tools shown in Table 3.6, Program Outcome *(d)* has been achieved and no actions are needed.

(e) an ability to identify, formulate, and solve engineering problems (ABET: e)

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[2] Program Outcome Notebooks will be available to the ABET evaluator during the time of visit.

Out of three assessment tools, based on the results of two tools this outcome has been achieved as shown in Table 3.7. However, in order to achieve the course level assessment goals, similar actions to Program Outcome (a) should be taken.

(f) an understanding of professional and ethical responsibility and the consequences of failing in it (ABET: f)

Based on three assessment tools shown in Table 3.8, Program Outcome (*f)* has been achieved and no actions are needed. In the year 2001, based on the EBI survey, data for this outcome was below the set standard. However, we believe a new seminar course on ethics by the Liberal Studies remedied this problem the next year.

(g) an ability to communicate effectively in both oral and written fashion (ABET: g)

Based on four assessment tools, shown in Table 3.9, the program achieves this outcome. However, continued review of the issue is recommended using the assessment tools.

(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context (ABET: h)

Based on the assessment tools, shown in Table 3.10, the program has achieved this outcome, and at this time no action is needed.

(i) an appreciation of the need for, and preparedness to engage in life-long learning (ABET: i)

According to the information given in Table 3.11, this program outcome has been achieved, and at this time no action is needed.

(j) a knowledge of contemporary social, economical and political issues and their impact on the engineering profession (ABET: j)

According to the information given in Table 3.12, this program outcome has been achieved, and at this time no action is needed.

(k) an ability and experience in using the techniques, skills, and modern engineering tools necessary for engineering practice (ABET: k)

According to the information given in Table 3.13, this program outcome has been achieved, and at this time no action is needed.

(l) a knowledge of computer science and computer engineering, and engineering sciences necessary to analyze and design systems containing hardware and software components (IEEE).

According to the assessment tool the standard could not be achieved and further action was necessary as explained in Table 3.14. Moreover, after testing the new curriculum for one year, the faculty of the Electrical Engineering Program has decided to include a required course in the area of Microcomputers in order to strengthen the achievement of this program outcome. The implementation of this action took place Fall 2003.

Table 3.3 ***PROGRAM OUTCOME*** **(a)**:

an ability to solve electrical engineering problems by applying knowledge of such fundamental and advanced mathematics as calculus, differential equations, linear algebra, probability and statistics, science, and engineering principles.

Assessment Method And Standards	Assessment Results	Conclusions	Actions Taken
1. Prerequisite tests for the core courses in EE program	1. EE210 Circuits I Average Fall 2001: 59% Winter 2002: 62.25% Spring 2002: Winter 2003: 76%	• A good number of students have missed a question that requires finding the maximum value of a function. • Often students appeared to be unable to correctly execute the multiple steps required to solve a problem. • In regards to the other questions, student performance was rather reasonable. • Weakness is detected in mathematical operations of sinusoidal functions.	The students have been advised to review fundamentals of calculus with the help of tutoring center. Review sinusoidal functions in class.
	2. EE320 Electronics I Number of students attempting the test: 124 Average Fall 2001 – Winter 2003: 66.3%	Following weaknesses were observed: • Simple Thevenin's equivalent circuit • Weakness is detected in mathematical operations of sinusoidal functions.	Poor application of elementary circuit analysis indicates that students have retained little circuit theory over their work term. A package of topics worthy of review should be provided to students on the first day of class with an accompanying homework assignment. The importance of a strong grasp of circuit theory needs to be emphasized by Electronics I instructors.

PROGRAM OUTCOME (a): *(continued)*

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
2. <u>Common final exams for the core courses in EE program</u> **It is expected to have an average of 80% or higher in the above tests**	**1. <u>EE210 Circuits I</u>** **<u>Average</u>** **Spring 2001: 76%** **Summer 2001: 76%** **Fall 2001: 79%** **Winter 2002:** **Spring 2002 :** **Fall 2002: 71%**	• **Out of 30 questions 18 and 21 of them were correctly answered by 80% of the students in March and June exams, respectively.** • **More number of students missed the questions on Node-voltage, method, Thevenin's theorem and superposition theorem.** • **Series resistance calculation was done correctly by all the students.** • **Students have difficulty in writing equations using KVL and KCL. Voltage polarities seem to cause confusion.** • **45% of the students could not use the V-I relationships of inductors and capacitors correctly.** • **A large number of students have difficulty in analyzing ac circuits, obtaining phasor representation and performing impedance calculations.**	**To improve the student learning small changes on the number of hours spent on topics such as Node-voltage method, Thevenin's theorem and superposition theorem.** **A brief review of calculus fundamentals as they apply to EE concepts.** **More time should be devoted to node-voltage method, inductors and capacitor calculations, ac circuits and phasor circuit analysis. Students should be made more familiar with complex number calculations.**

PROGRAM OUTCOME (a): ***(continued)***

Assessment Method and Standards	**Assessment Results**	**Conclusions**	**Actions Taken**
2. <u>Common final exams for the core courses in EE program</u> **It is expected to have an average of 80% or higher in the above tests**	**2. <u>EE230 Signals and systems</u>** **<u>Average</u>** **Fall 2001: 47%** **Winter 2002 : 54%** **Summer 2002: 66%** **Fall 2002: 67%**	• **55% of the students successfully answered a question on:** **Given a plotted, discrete-time signal write a mathematical expression.** **Find the fundamental period for a sinusoid.** **Determine system properties for both discrete and continuous systems.** • **62% of the students answered a question correctly on determining the impulse response using Laplace transform along with partial fraction expansion.** • **62% of the students could answer a question on z-transforms correctly.** • **52% of students could solve a first-order difference equation as completely as possible.**	**<u>Fall 2001:</u> Iterative solution of difference equations was removed as a required component of course. Only zero-state solutions were required. Student requirement to memorize specific transform pairs and properties was removed in lieu of providing a set of tables for the test.** **<u>Spring 2002:</u> Fundamental period for a single sinusoid is required rather than for a sum of sinusoids. Partial fraction expansion is required for only real and unique or real and repeated roots. Solution of differential equations with arbitrary input and initial conditions is required. Time domain solution for difference equations is not in the suggested text book, so the course information distributed to teaching faculty has been modified to indicate that supplementary material may be required if that text is used.** **<u>Winter 2003:</u> Changes in the course catalog to reflect material being covered but not listed (system propertied and impulse response).**

PROGRAM OUTCOME (a): ***(continued)***

Assessment Method and Standards	**Assessment Results**	**Conclusions**	**Actions Taken**
2. <u>Common final exams for the core courses in EE program</u> **It is expected to have an average of 80% or higher in the above tests**	**3. <u>EE240 Electromagnetic Fields</u>** **<u>Average</u>** **Winter, Spring, Summer and Fall terms of 2002: 33.33%**	• **The results for each of the test topic were poor over this time period.** • **Greater than 50% of the students failed most of the topic questions.** • **The performance was especially poor in topics related to the magnetic force on a current-carrying loop and the use of Maxwell's equation in both the time and frequency domains.**	**During the Winter 2003 term, several measures were implemented in an attempt to improve the performance of the students.** **First, it was required that students pass at least five questions out of nine on the assessment exam in order to pass the course.** **Second, the last three weeks were dedicated to preparing students for the test by going over hundreds of possible questions.** **For the Winter 2003 term, the class performance was excellent. Only one student did not pass the assessment examination.** **To assist students to be successful, it is recommended that the last 1½ to 2 weeks of the term be devoted to exam preparation. Based on the experience from the Winter 2003 term, 3 weeks of preparation is unnecessary.**

PROGRAM OUTCOME (a): ***(continued)***

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
2. <u>Common final exams for the core courses in EE program</u> **It is expected to have an average of 80% or higher in the above tests**	**4. <u>EE310 Circuits II</u>** **Number of students attempting the test over two terms: 56** **<u>Average</u>** **Spring 2002 : 51%** **Summer 2002: 42%**	• **57% of the students successfully analyzed balanced 3-phase circuits and calculate 3-phase power.** • **11% of the students could define series and parallel resonance, calculate quality factor and bandwidth.** • **43% of the students were able to find a circuit's transfer function from a Bode plot.** • **70% of the students could define an ideal transformer, find primary and secondary side variables.** • **72% of the students could find the initial conditions and time constants for first and second order circuits, and determine the natural and forced response using classical and Laplace methods.** • **30% of the students predicted time-domain circuit response from Bode plots correctly.** • **39% of the students determine and apply the Fourier series expansion to periodic signals correctly.**	**Reschedule the number of class periods spent on each topic.** **Have course coordinator more involved in selection of tutors.** **Look for study-aids, especially interactive media, for student use.**

PROGRAM OUTCOME **(a):** ***(continued)***

Assessment Method and Standards	**Assessment Results**	**Conclusions**	**Actions Taken**
2. <u>Common final exams for the core courses in EE program</u> **It is expected to have an average of 80% or higher in the above tests**	**5. <u>EE 320 Electronics I</u>** **Number of students attempting the test: 109** **<u>Average</u>** **Fall 2001 – Winter 2003: 52.4%**	**In general terms, students had the least trouble with operational amplifier problems, but performance in problems dealing with diodes, BJT's and MOSFET's was well below that expected. Since most of the questions were at the same level as homework assignments, the test problems do not appear to be unreasonably difficult. Problem types are summarized along with performance results in a table on the following page.**	**Poor performance in diode, BJT, and MOSFET areas indicates that more emphasis must be placed on students doing their homework. Many of the areas covered by the test problems are subjects of laboratory experiments, so more emphasis on the theoretical aspects of laboratory experiments should be stressed.** **A one-hour per week recitation period could be introduced to enhance and reinforce course material.**

PROGRAM OUTCOME (a): *(continued)*

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
2. <u>Common final exams for the core courses in EE program</u> **It is expected to have an average of 80% or higher in the above tests**	**6. <u>CE 210 Digital Systems I</u>** **Number of students attempting the test: 109** **<u>Average</u>** **Fall 2001 : 63.4%** **Winter 2002: 56.4%** **Spring 2002: 60.5%** **Summer 2002: 61.8%**	**Major difficulty with students learning was on Karnaugh maps and number system conversions.**	**The amount of teaching time was increased for Karnaugh maps, only a modest improvement was observed in student performance. Moreover, a series of standard tutorial/practice materials will be developed to offer to students in all sections of CE-210. They will address course learning objectives on which students have scored poorly, and be developed in priority order as time allows. The first installment, in Summer 2003, will be on Karnaugh maps.**

PROGRAM OUTCOME **(a):** ***(continued)***

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
<u>3. Senior Design Project assessment</u> (evaluation by EE Senior Design Assessment Committee) Assessment of Student Work; Over-all rating and Item 7 rating. Item 7: Consider each of the following factors in the design: a) Cost, b)Manufacturability, c) Environmental impact and/or sustainability, d) Public health and/or product safety, e) Social and/or political factors, f) Ethical issues. Evaluated on 5 point scale, 5= excellent, 3=satisfactory, 1= needs improvement. Standard: Rating in the excellent – satisfactory range (>3).	Over-all rating: Summer 2001: 3.82 Spring 2002: 3.05 Summer 2002: 4.06 Fall 2002: 3.14 Item 7 rating: Summer 2001: 2.00 Spring 2002: 2.5 Summer 2002: 3.33 Fall 2002: 3.5	Over-all ratings for all terms assessed are in the excellent-satisfactory range (>3) meeting the program standard. Item 7 rating have been in the excellent-satisfactory range (>3) for the past 2 terms meeting the program standard.	No action is required.

PROGRAM OUTCOME **(a):** ***(continued)***

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
4. <u>EBI survey</u> Q52, Q53, Q54 To what degree did your engineering education enhance your ability to apply your knowledge of: Q52.Mathematics? Q53. Science? Q54. Engineering? (7 point scale, 7=extremely, 4=moderately, 1=not at all) Standard: It is expected to have a rating greater than or equal to 4.	In years 2000 and 2001 there were no questions similarly addressing the issues of Q52, Q53 and Q54. <u>2002</u> Q52. KU: 5.60 Q53. KU: 5.44 Q54. KU: 5.33	Q52. Meets program standard (>4). Q53. Meets program standard (>4). Q54. Meets program standard (>4).	No action is required.

Table 3.4 *PROGRAM OUTCOME* (b):

an ability to design and conduct experiments in electrical engineering, as well as to collect, analyze and interpret data to reach appropriate conclusions.

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
<u>1. EBI survey</u> Q38, Q39, Q40 To what degree did your engineering education enhance your ability to: Q38. Design experiments? Q39. Conduct experiments? Q40. Analyze and interpret data? (7 point scale, 7=extremely, 4=moderately, 1=not at all) Standard: It is expected to have a rating greater than or equal to 4. (7 point scale, 7=extremely, 4=moderately, 1=not at all) ***<u>Standard:</u>*** Rating in the extremely-moderately range (>4), > Select 6 rating, and positive trend over 3 years.	<u>2002</u> Q38. KU: 5.14 Select 6: 4.88 Q39. KU: 5.31 Select 6: 5.16 Q40. KU: 5.53 Select 6: 5.32 <u>2001</u> Q38. KU: 5.00 Select 6: 5.31 Q39. KU: 6.40 Select 6: 5.51 Q40. KU: 6.40 Select 6: 5.55 <u>2000</u> Q38. KU: 5.33 Select 6: 5.21 Q39. KU: 5.44 Select 6: 5.22 Q40. KU: 5.81 Select 6: 5.31	Q38,Q39,Q40. Meets program standard (>4) for 2002. Always there is a positive trend compared to Select 6. Q38,Q39,Q40. Meets program standard (>4) for 2002. It is all positive trend except Q38 compared Select 6. Q38,Q39,Q40. Meets program standard (>4) for 2002. Always there is a positive trend compared to Select 6.	In 2000, 2001 and 2002 the results appear to exceed the standard. Thus no action is recommended.

PROGRAM OUTCOME (b): *(continued)*

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
2. <u>Senior thesis project</u> (Data is for respondents who are in the BEE degree program.) These surveys assess the student's academic preparation and how their co-op work experience has contributed to the Senior Thesis Project. ***<u>Survey of EE students</u>:*** **Q2 – Developed your ability to conduct experiments, analyze and interpret data.**	**<u>March 2003:</u>** **<u>Q2:</u>** **68 out of 70 responses (97%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Survey of faculty advisors:</u> **Q2 – Demonstrated the ability to conduct experiments, analyze and interpret data.**	**<u>March 2003:</u>** **<u>Q2:</u>** **36 out of 36 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Survey of employer advisors:</u> **Q2 – Demonstrated the ability to conduct experiments, analyze and interpret data.** ***<u>Standard:</u>*** **It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or Strongly Agree" in this survey.**	**<u>March 2003:</u>** **<u>Q2:</u>** **64 out of 64 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**

PROGRAM OUTCOME **(b):** ***(continued)***

Assessment Method and Standards	**Assessment Results**	**Conclusions**	**Actions Taken**
3. <u>Co-op program work</u> (Data is for respondents who are in the BEE degree program.) ***<u>Survey of BEE students:</u>*** **Evaluation of Academic Preparation from KU for your Co-op Work Term: Q2-Ability to design and conduct experiments, analyze and interpret data.**	**<u>March 2003:</u> <u>Q2:</u> 198 out of 218 responses (91%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
Assess how this cooperative education experience has contributed to your overall education: **Q2- Ability to design and conduct experiments, analyze and interpret data.**	**<u>March 2003:</u> <u>Q2:</u> 252 out of 273 responses (92%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Survey of co-op supervisors:</u> **Assess the student's academic preparation for cooperative education assignment:** **Q2- Demonstrated the ability to design and conduct experiments, analyze and interpret data.** ***<u>Standard:</u>*** **It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or "Strongly Agree" in this survey.**	**<u>March 2003:</u> <u>Q2:</u> 160 out of 160 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards**	**Data indicates that no action is required.**

Table 3.5 ***PROGRAM OUTCOME*** **(c):**

an ability to design an electrical system, component, or process to meet desired technical, environmental, safety and economical specifications.

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
1. <u>Senior Design Project portfolio</u> (evaluation by EE Senior Design Assessment Committee) Assessment of Student Work; Over-all rating and Item 7 rating. Item 7: Consider each of the following factors in the design: a) Cost, b) Manufacturability, c) Environmental impact and/or sustainability, d) Public health and/or product safety, e) Social and/or political factors, f) Ethical issues. Evaluated on 5 point scale, 5= excellent, 3=satisfactory, 1= needs improvement. Standard: Rating in the excellent – satisfactory range (>3).	Over-all rating: Summer 2001: 3.82 Spring 2002: 3.05 Summer 2002: 4.06 Fall 2002: 3.14 Item 7 rating: Summer 2001: 2.00 Spring 2002: 2.5 Summer 2002: 3.33 Fall 2002: 3.5	Over-all ratings for all terms assessed are in the excellent-satisfactory range (>3) meeting the program standard. Item 7 rating have been in the excellent-satisfactory range (>3) for the past 2 terms meeting the program standard.	No action is required.

PROGRAM OUTCOME **(c):** ***(continued)***

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
<u>2. EBI survey</u> **Q41. To what degree did your engineering education enhance your ability to design a system, component, or process to meet desired needs?** **Q61 ,Q62, Q66. To what degree did your major design experience address:** **Q61. Economic issues?** **Q62. Environmental issues?** **Q66. Health and safety issues?** **(7 point scale, 7=extremely, 4=moderately, 1=not at all)** **Standard: Rating in the extremely-moderately range (>4), > Select 6 rating, and positive trend over 3 years.**	**2002** **Q41. KU: 5.36** **Select 6: 5.32** **Q61. KU 4.05** **Select 6: 4.38** **Q62. KU 3.48** **Select 6: 3.55** **Q66. KU 3.84** **Select 6: 3.76** **2001** **Q41. KU: 5.60** **Q61. KU: 4.60** **Q62. KU: 3.00** **Q66. KU: 3.80** **2000** **Q41. KU: 5.56** **Q61. KU: 5.00** **Q62. KU: 4.14** **Q66. KU: 4.47**	**Q41. Meets program standard (>4) for 2002.** **KU +0.04 compared to Select 6.** **No clear trend.** **Q61. Meets program standard (>4) for 2002.** **KU –0.33 compared to Select 6.** **Negative trend noted.** **Q62. Does not meet program standard (>4) for 2002.** **KU –0.07 compared to Select 6.** **No clear trend.** **Q66. Does not meet program standard (>4) for 2002.** **KU +0.08 compared to Select 6.** **Negative trend noted.**	**Q41 indicates no action required. Monitor trend for 2003.** **Q61, Q62 and Q66 indicate action required. Recommend to EE Design Assessment Committee that more emphasis be placed on Economic, Environmental and Health and safety issues in EE-490 Design Project Assignments.**

PROGRAM OUTCOME **(c):** ***(continued)***

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
3. <u>Senior thesis project</u> (Data is for respondents who are in the BEE degree program.) These surveys assess the student's academic preparation and how their co-op work experience has contributed to the Senior Thesis Project.			
***<u>Survey of EE students</u>:* Q3 – Developed your ability to design a system, component or process to meet desired needs.**	**<u>March 2003:</u> 65 out of 67 responses (97%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
***<u>Survey of faculty advisors:</u>* Q3 – Demonstrated the ability to design a system, component or process to meet desired needs.**	**<u>March 2003:</u> 39 out of 39 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
***<u>Survey of employer advisors:</u>* Q3 – Demonstrated the ability to design a system, component or process to meet desired needs.**	**<u>March 2003:</u> 63 out of 63 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
***<u>Standard:</u>* It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or "Strongly Agree" in this survey.**			

PROGRAM OUTCOME (c): *(continued)*

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
4. <u>Co-op program work</u> **(Data is for respondents who are in the BEE degree program.)** ***<u>Survey of EE students:</u>*** **Evaluation of Academic Preparation from KU for your Co-op Work Term: Q3 – Ability to design a system, component or process to meet desired needs.**	**Feb. 2003 175 out of 212 responses (83%) "Agree" or "Strongly Agree."**	**Not satisfactory based on the data available. Does not meet program standards, however, conclusions are based on co-op experience at all degree levels, freshman through senior.**	**Data indicates action is required. It is recommended that Q3 of this survey be administered to seniors only for future assessment.**
Assess how this cooperative education experience has contributed to your overall education: Q3 - Ability to design a system, component or process to meet desired needs.	**Feb. 2003 249 out of 264 responses (94%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Survey of co-op supervisors:</u> **Assess the student's academic preparation for cooperative education assignment: Q3 – Demonstrated the ability to design a system, component or process to meet desired needs.** **<u>Standard:</u>** **It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or "Strongly Agree" in this survey.**	**Feb. 2003 160 out of 162 responses (99%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**

Table 3.6 *PROGRAM OUTCOME* (d):

an ability to participate and contribute in multi-disciplinary team activities.

Assessment Method and Standards	Assessment Results	Conclusions	Action Taken
1. <u>EBI surveys</u> Q17. How do you rate your satisfaction with the value derived from team experiences? Q31. How satisfied were you with the ability of fellow students to work in teams? Q42. To what degree did your engineering education enhance your ability to function on multidisciplinary teams? (7 point scale, 7=extremely, 4=moderately, 1=not at all) ***Standard:*** It is expected to have a rating greater than or equal to 4 for the above questions.	<u>2002</u> Q17. KU: 5.24 Select 6: 5.49 Q31. KU: 5.14 Select 6: 5.26 Q42. KU: 5.16 Select 6: 5.33	Q17, Q31, Q42 meet program standard (>4) for 2002. Negative trend is noted compared to Select 6.	No action is required.
	<u>2001</u> Q17. KU: 5.20 Select 6: 5.34 Q31. KU: 5.40 Select 6: 5.21 Q42. KU: 6.20 Select 6: 5.36	Q17, Q31, Q42 meet program standard (>4) for 2002. Negative trend is noted compared to Select 6 in Q17. Q31 and Q42 indicated positive trends for the same comparison.	No action is required.
	<u>2000</u> Q17. KU: 5.44 Select 6: 4.91 Q31. KU: 5.50 Select 6: 4.75 Q42. KU: 5.60 Select 6: 5.18	Q17, Q31, Q42 meet program standard (>4) for 2002. Positive trend is noted compared to Select 6 in Q17, Q31 and Q42.	No action is required.

PROGRAM OUTCOME (d): *(continued)*

Assessment Method and Standards	Assessment Results	Conclusions	Action Taken
2. Senior thesis project **(Data is for respondents who are in the BEE degree program.)** **These surveys assess the student's academic preparation and how their co-op work experience has contributed to the Senior Thesis Project.** ***Survey of EE students:*** **Q4– Developed your ability to function on multi-disciplinary teams.**	**March 2003:** **Q4:** **49 out of 51 responses (96%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
Survey of faculty advisors: **Q4 – Demonstrated the ability to function on multi-disciplinary teams.**	**March 2003:** **Q4:** **28 out of 28 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
Survey of employer advisors: **Q4– Demonstrated the ability to function on multi-disciplinary teams.**	**March 2003:** **Q4:** **59 out of 59 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
Standard: **It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or**			

PROGRAM OUTCOME (d): ***(continued)***

Assessment Method and Standards	Assessment Results	Conclusions	Actions taken
3. <u>Co-op program work</u> (Data is for respondents who are in the BEE degree program.) ***<u>Survey of EE students:</u>*** **Evaluation of Academic Preparation from KU for your Co-op Work Term:** **Q4-Ability to function on multi-disciplinary teams.**	**<u>March 2003:</u> <u>Q4:</u> 213 out of 229 responses (93%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
Assess how this cooperative education experience has contributed to your overall education: **Q4-Ability to function on multi-disciplinary teams.**	**<u>March 2003:</u> <u>Q4:</u> 282 out of 294 responses (96%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Survey of co-op supervisors:</u> **Assess the student's academic preparation for cooperative education assignment: Q4- Demonstrated the ability to function on multi-disciplinary teams.** ***<u>Standard:</u>*** **It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or "Strongly Agree" in this survey.**	**<u>March 2003:</u> <u>Q4:</u> 173 out of 174 responses (99%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards**	**Data indicates that no action is required.**

Table 3.7 ***PROGRAM OUTCOME*** **(e):**

an ability to identify, formulate, and solve engineering problems

Assessment Method and Standards	Assessment Results	Conclusions	Actions taken
1. <u>Common final exams for the core courses in EE program</u> It is expected to have an average of 80% or higher in the above tests	1. <u>EE210 Circuits I</u> <u>Average</u> Spring 2001: 76% Summer 2001: 76% Fall 2001: 79% Winter 2002: Spring 2002 : Fall 2002: 71%	• Out of 30 questions 18 and 21 of them were correctly answered by 80% of the students in March and June exams, respectively. • More number of students missed the questions on Node-voltage, method, Thevenin's theorem and superposition theorem. • Series resistance calculation was done correctly by all the students. • Students have difficulty in writing equations using KVL and KCL. Voltage polarities seem to cause confusion. • 45% of the students could not use the V-I relationships of inductors and capacitors correctly. • A large number of students have difficulty in analyzing ac circuits, obtaining phasor representation and performing impedance calculations.	To improve the student learning small changes on the number of hours spent on topics such as Node-voltage method, Thevenin's theorem and superposition theorem. A brief review of calculus fundamentals as they apply to EE concepts. More time should be devoted to node-voltage method, inductors and capacitor calculations, ac circuits and phasor circuit analysis. Students should be made more familiar with complex number calculations.

PROGRAM OUTCOME (e): *(continued)*

Assessment Method and Standards	Assessment Results	Conclusions	Actions taken
1. Common final exams for the core courses in EE program **It is expected to have an average of 80% or higher in the above tests**	**2. EE230 Signals and systems** **Average** **Fall 2001: 47%** **Winter 2002 : 54%** **Summer 2002: 66%** **Fall 2002: 67%**	• **55% of the students successfully answered a question on:** **Given a plotted, discrete-time signal write a mathematical expression. Find the fundamental period for a sinusoid. Determine system properties for both discrete and continuous systems.** • **62% of the students answered a question correctly on determining the impulse response using Laplace transform along with partial fraction expansion.** • **62% of the students could answer a question on z-transforms correctly.** • **52% of students could solve a first-order difference equation as completely as possible.**	**Fall 2001: Iterative solution of difference equations was removed as a required component of course. Only zero-state solutions were required. Student requirement to memorize specific transform pairs and properties was removed in lieu of providing a set of tables for the test.** **Spring 2002: Fundamental period for a single sinusoid is required rather than for a sum of sinusoids. Partial fraction expansion is required for only real and unique or real and repeated roots. Solution of differential equations with arbitrary input and initial conditions is required. Time domain solution for difference equations is not in the suggested text book, so the course information distributed to teaching faculty has been modified to indicate that supplementary material may be required if that text is used.** **Winter 2003: Changes in the course catalog to reflect material being covered but not listed (system propertied and impulse response).**

PROGRAM OUTCOME (e): *(continued)*

Assessment Method and Standards	Assessment Results	Conclusions	Actions taken
1. <u>Common final exams for the core courses in EE program</u> It is expected to have an average of 80% or higher in the above tests	3. <u>EE240 Electromagnetic Fields</u> <u>Average</u> Wnter, Spring, Summer and Fall terms of 2002: 33.33%	• The results for each of the test topic were poor over this time period. • Greater than 50% of the students failed most of the topic questions. • The performance was especially poor in topics related to the magnetic force on a current-carrying loop and the use of Maxwell's equation in both the time and frequency domains.	During the Winter 2003 term, several measures were implemented in an attempt to improve the performance of the students. First, it was required that students pass at least five questions out of nine on the assessment exam in order to pass the course. Secondly, the last three weeks were dedicated to preparing students for the test by going over hundreds of possible questions. For the Winter 2003 term, the class performance was excellent. Only one student did not pass the assessment examination. To assist students to be successful, it is recommended that the last 1½ to 2 weeks of the term be devoted to exam preparation. Based on the experience from the Winter 2003 term, 3 weeks of preparation is unnecessary.

PROGRAM OUTCOME (e): *(continued)*

Assessment Method and Standards	Assessment Results	Conclusions	Actions taken
1. <u>Common final exams for the core courses in EE program</u> It is expected to have an average of 80% or higher in the above tests	4. <u>EE310 Circuits II</u> Number of students attempting the test over two terms: 56 <u>Average</u> Spring 2002 : 51% Summer 2002: 42%	• 57% of the students successfully analyzed balanced 3-phase circuits and calculate 3-phase power. • 11% of the students could define series and parallel resonance, calculate quality factor and bandwidth. • 43% of the students were able to find a circuit's transfer function from a Bode plot. • 70% of the students could define an ideal transformer, find primary and secondary side variables. • 72% of the students could find the initial conditions and time constants for first and second order circuits, and determine the natural and forced response using classical and Laplace methods. • 30% of the students predicted time-domain circuit response from Bode plots correctly. • 39% of the students determine and apply the Fourier series expansion to periodic signals correctly.	Reschedule the number of class periods spent on each topic. Have course coordinator more involved in selection of tutors. Look for study-aids, especially interactive media, for student use.

PROGRAM OUTCOME (e): *(continued)*

Assessment Method and Standards	**Assessment Results**	**Conclusions**	**Actions taken**
1. <u>Common final exams for the core courses in EE program</u> **It is expected to have an average of 80% or higher in the above tests**	**5. <u>EE 320 Electronics I</u>** **Number of students attempting the test: 109** **<u>Average</u>** **Fall 2001 – Winter 2003: 52.4%**	**In general terms, students had the least trouble with operational amplifier problems, but performance in problems dealing with diodes, BJT's and MOSFET's was well below that expected. Since most of the questions were at the same level as homework assignments, the test problems do not appear to be unreasonably difficult. Problem types are summarized along with performance results in a table on the following page.**	**Poor performance in diode, BJT, and MOSFET areas indicates that more emphasis must be placed on students doing their homework. Many of the areas covered by the test problems are subjects of laboratory experiments, so more emphasis on the theoretical aspects of laboratory experiments should be stressed.** **A one-hour per week recitation period could be introduced to enhance and reinforce course material.**

PROGRAM OUTCOME (e): ***(continued)***

Assessment Method and Standards	**Assessment Results**	**Conclusions**	**Actions taken**
1. <u>Common final exams for the core courses in EE program</u> **It is expected to have an average of 80% or higher in the above tests**	**6. <u>CE 210 Digital Systems I</u>** **Number of students attempting the test: 109** **<u>Average</u>** **Fall 2001 : 63.4%** **Winter 2002: 56.4%** **Spring 2002: 60.5%** **Summer 2002: 61.8%**	**<u>Major difficulty with students learning was on Karnaugh maps.</u>**	**<u>The amount of teaching time was increased for Karnaugh maps, only a modest improvement was observed in student performance</u>**

PROGRAM OUTCOME (e): *(continued)*

Assessment Method and Standards	Assessment Results	Conclusions	Actions taken
2. <u>Senior thesis project</u> (Data is for respondents who are in the BEE degree program.) These surveys assess the student's academic preparation and how their co-op work experience has contributed to the Senior Thesis Project. ***<u>Survey of EE students</u>:*** Q6 – Developed your ability to identify, formulate and solve engineering problems.	March 2003: <u>Q6:</u> 69 out of 70 responses (99%) "Agree" or "Strongly Agree."	Satisfactory based on the data available. Meets program standards.	No action is required
<u>Survey of faculty advisors:</u> Q6 – Developed your ability to identify, formulate and solve engineering problems.	<u>March 2003:</u> <u>Q6:</u> 38 out of 38 responses (100%) "Agree" or "Strongly Agree."	Satisfactory based on the data available. Meets program standards.	No action is required
<u>Survey of employer advisors:</u> Q6 – Developed your ability to identify, formulate and solve engineering problems. <u>Standard:</u> It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or Strongly Agree" in this survey.	<u>March 2003:</u> <u>Q6:</u> 65 out of 65 responses (100%) "Agree" or "Strongly Agree."	Satisfactory based on the data available. Meets program standards.	No action is required

PROGRAM OUTCOME (e): *(continued)*

Assessment Method and Standards	Assessment Results	Conclusions	Actions taken
3. <u>EBI survey</u> **Q55, Q56 To what degree did your engineering education enhance your ability to:** **Q55.Identify?** **Q56.Formulate?** **(7 point scale, 7=extremely, 4=moderately, 1=not at all)** **Standard: It is expected to have a rating greater than or equal to 4.**	**In years 2000 and 2001 there were no questions similarly addressing the issues of Q55 and Q56.** **<u>2002</u>** **Q55. KU: 5.22** **Select 6: 5.72** **Q56. KU: 5.19** **Select 6: 5.40**	**Q55,Q56 meet program standard (>4) for 2002. Negative trend is noted compared to Select 6.**	**No action is required. However, this data should be closely monitored to see the comparison with Select 6.**

Table 3.8 ***PROGRAM OUTCOME*** **(f):**

an understanding of professional and ethical responsibility and the consequences of failing in it.

Assessment Method and Standards	Assessment Results	Conclusions	Action Taken
<u>1.Evaluation of a paper prepared by each student addressing issues of *"Social Sciences".*</u> This paper is assessed by Liberal Studies Department at KU Assessment items relevant to this program outcome are: 1. Displays an understanding of ethical and moral thinking. 2. Displays an understanding of the nature and variety of ethical systems. 3. Displays an understanding of the relationship between individual actions and larger social phenomena. *<u>Standard:</u>* It is expected an average grade >2 out of 4 to these items as set by the Liberal Studies Department.	Summer 2002 - Winter 2003: Average: 1.72	The average grade of the assessment could not meet the standard grade set by the Department of Liberal Studies is (>2).	Liberal Studies program should emphasize more on issues related to this outcome throughout their program.

PROGRAM OUTCOME **(f):** ***(continued)***

Assessment Method and Standards	Assessment Results	Conclusions	Action Taken
2. <u>EBI surveys</u> **Q45. To what degree did your engineering education enhance your ability to understand ethical responsibilities?** **(In 2002, Q44 addressed the same questions.)** **(7 point scale, 7=extremely, 4=moderately, 1=not at all)** **Standard: It is expected to have a rating greater than or equal to 4 for the above questions.**	**<u>2002</u>** **Q44. KU: 4.49** **Select 6: 4.62**	**Q44. Meets program standard (>4) for 2002.** **KU -0.13 compared to Select 6.** **Negative trend noted.**	**No action is required.**
	<u>2001</u> **Q45. KU: 3.80** **Select 6: 4.47**	**Q44. Does not meet program standard (>4) for 2001.** **KU -0.67 compared to Select 6.** **Negative trend noted.**	**In year 2001, a new course entitled Liberal Studies seminar was included in the electrical engineering curriculum in order to enhance the understanding of such issues as ethical responsibilities.**
	<u>2000</u> **Q45. KU: 5.13** **Select 6: 4.62**	**Q44. Meets program standard (>4) for 2002.** **KU 0.51 compared to Select 6.** **Positive trend noted.**	**No action is required.**

PROGRAM OUTCOME **(f):** ***(continued)***

Assessment Method and Standards	**Assessment Results**	**Conclusions**	**Action Taken**
3. <u>Senior thesis project</u> **(Data is for respondents who are in the BEE degree program.)** **These surveys assess the student's academic preparation and how their co-op work experience has contributed to the Senior Thesis Project.** ***<u>Survey of EE students</u>:*** **Q5 – Developed your understanding of professional and ethical responsibility.**	**<u>March 2003:</u>** **<u>Q5:</u>** **65 out of 71responses (92%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**No action is required**
<u>Survey of faculty advisors:</u> **Q5 – Demonstrated understanding of professional and ethical responsibility.**	**<u>March 2003:</u>** **<u>Q6:</u>** **31 out of 31 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**No action is required**
<u>Survey of employer advisors:</u> **Q5 – Demonstrated understanding of professional and ethical responsibility.**	**<u>March 2003:</u>** **<u>Q6:</u>** **64 out of 65 responses (98%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**No action is required**
<u>Standard:</u> **It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or Strongly Agree" in this survey.**			

PROGRAM OUTCOME **(f):** ***(continued)***

Assessment Method and Standards	Assessment Results	Conclusions	Action taken
4. <u>Co-op program work</u> **(Data is for respondents who are in the BEE degree program.)** ***<u>Survey of EE students:</u>*** **Evaluation of Academic Preparation from KU for your Co-op Work Term:** **Q6-Understanding of professional and ethical responsibility.**	**<u>March 2003:</u>** **<u>Q6:</u>** **227 out of 249 responses (91%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
Assess how this cooperative education experience has contributed to your overall education: **Q6-Understanding of professional and ethical responsibility.**	**<u>March 2003:</u>** **<u>Q6:</u>** **309 out of 316 responses (98%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Survey of co-op supervisors:</u> **Assess the student's academic preparation for cooperative education assignment:** **Q5- Demonstrated understanding of professional and ethical responsibility.** ***<u>Standard:</u>*** **It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or "Strongly Agree" in this survey.**	**<u>March 2003:</u>** **<u>Q5:</u>** **181 out of 184 responses (98%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**

Table 3.9 ***PROGRAM OUTCOME*** **(g):**

an ability to communicate effectively in both oral and written fashion

Assessment Method and Standards	Assessment Results	Conclusions	Action Taken
1. Standard test given for *"written communications"* by Liberal Studies Department at KU **Standard:** **It is expected a grade >2 out of 4 as set by the Liberal Studies Department.**	**Summer 2002 - Winter 2003:** **Average: 2.36**	**The average of the standard test given by the Department of Liberal Studies is (>2) meeting the program standard. However, in some specific areas some students appear to have difficulties.**	**No action is required. However, this data should be closely monitored to see the future trend.**

PROGRAM OUTCOME (g): *(continued)*

Assessment Method and Standards	Assessment Results	Conclusions	Action Taken
<u>2. EBI survey</u> **Q48, Q49 To what degree did your engineering education enhance your ability to communicate using:** **Q48. Oral** **Q49. Written progress reports?** **(In 2002 EBI, these questions were renumbered as Q47 and Q48.)** **(7 point scale, 7=extremely, 4=moderately, 1=not at all)** ***<u>Standard:</u>*** **Rating in the extremely-moderately range (>4), > Select 6 rating, and positive trend over 3 years.**	**2002** **Q47. KU: 4.81** **Select 6: 5.22** **Q48. KU: 4.83** **Select 6: 5.35** **2001** **Q48. KU: 3.80** **Select 6: 4.84** **Q49. KU: 3.80** **Select 6: 5.23** **2000** **Q48. KU: 5.50** **Select 6: 4.94** **Q49. KU: 5.63** **Select 6: 5.23**	**Q47. Meets program standard (>4) for 2002.** **KU -0.41 compared to Select 6.** **Negative trend noted.** **Q48. Meets program standard (>4) for 2002.** **KU –0.52 compared to Select 6.** **Negative trend noted. However, there is a significant improvement from 2001 to 2002.** **Q48. Does not meet program standard (>4) for 2001.** **KU –1.04 compared to Select 6.** **Negative trend noted.** **Q49. Does not meet program standard (>4) for 2001.** **KU -1.43 compared to Select 6.** **Negative trend noted.** **In 2000, both Q48 and Q49, not only meet the standard, but also exceeded the Select 6 averages.**	**In 2001 and 2002 the standards could not be met. Since there are two required courses in the area of Written and Oral Communications in the curriculum offered by the Liberal Studies Department. Hence, a memorandum was sent to the Liberal Studies department to take an action on the written and oral communication skills of the students.**

PROGRAM OUTCOME (g): *(continued)*

Assessment Method and Standards	Assessment Results	Conclusions	Action Taken
3. Senior thesis project (Data is for respondents who are in the BEE degree program.) These surveys assess the student's academic preparation and how their co-op work experience has contributed to the Senior Thesis Project. *Survey of EE students:* Q7a, Q7b – Demonstrated the ability to communicate effectively through: Q7a: Interpersonal skills. Q7b: Formal presentations.	**March 2003: Q7a: 65 out of 71 responses (92%) "Agree" or "Strongly Agree." Q7b: 58 out of 66 responses (88%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
***Survey of faculty advisors:* Q7a, Q7b – Demonstrated the ability to communicate effectively through: Q7a: Interpersonal skills. Q7b: Formal presentations.**	**March 2003: Q7a: 36 out of 37 responses (97%) "Agree" or "Strongly Agree." Q7b: 26 out of 26 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
***Survey of employer advisors:* Q7a, Q7b – Demonstrated the ability to communicate effectively through: Q7a: Interpersonal skills. Q7b: Formal presentations. *Standard:* It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or Strongly Agree" in this survey.**	**March 2003: Q7a: 63 out of 65 responses (97%) "Agree" or "Strongly Agree." Q7b: 53 out of 55 responses (96%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action required.**

PROGRAM OUTCOME **(g):** ***(continued)***

Assessment Method and Standards	Assessment Results	Conclusions	Action Taken
4. <u>Co-op program work</u> (Data is for respondents who are in the BEE degree program.) ***<u>Survey of EE students:</u>*** **Evaluation of Academic Preparation from KU for your Co-op Work Term: Q7a,Q7b– Ability to communicate effectively through:** **Q7a: Interpersonal skills.** **Q7b: Formal presentations.**	**<u>Feb. 2003:</u>** **<u>Q7a:</u>** **252 out of 255 responses (99%) “Agree” or “Strongly Agree.”** **<u>Q7b:</u>** **184 out of 195 responses (94%) “Agree” or “Strongly Agree.”**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
Assess how this cooperative education experience has contributed to your overall education: Q7a,Q7b– Ability to communicate effectively through: **Q7a: Interpersonal skills.** **Q7b: Formal presentations.**	**<u>Feb. 2003:</u>** **<u>Q7a:</u>** **474out of 481responses (99%) “Agree” or “Strongly Agree.”** **<u>Q7b:</u>** **353 out of 380 responses (93%) “Agree” or “Strongly Agree.”**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Survey of co-op supervisors:</u> **Assess the student’s academic preparation for cooperative education assignment:** *** Verbal: Ability to convey information and present ideas clearly and concisely.** ***Written: Ability to communicate through memos, reports, etc.** ***<u>Standard:</u>*** **It is expected to have 85% of the respondents for the electrical engineering program indicate “Agree” or “Strongly Agree” in this survey.**	**<u>Feb. 2003:</u>** **279 out of 280 responses (99%) “Agree” or “Strongly Agree.”** **237 out of 239 responses (99%) “Agree” or “Strongly Agree.”**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**

Table 3.10 ***PROGRAM OUTCOME*** **(h):**

the broad education necessary to understand the impact of engineering solutions in a global and societal context

Assessment Method and Standards	Assessment Results	Conclusions	Action Taken
<u>1. EBI survey</u> **Q46 To what degree did your engineering education enhance your ability to understand the impact of engineering solutions in a global/societal context?** **(In 2002 EBI, these questions were renumbered as Q47 and Q48.)** **(7 point scale, 7=extremely, 4=moderately, 1=not at all)** ***<u>Standard:</u>*** **Rating in the extremely-moderately range (>4), > Select 6 rating, and positive trend over 3 years.**	**2002** **Q46. KU: 4.49** **Select 6: 4.68** **2001** **Q46. KU: 4.20** **Select 6: 4.54** **2000** **Q46. KU: 4.94** **Select 6: 4.47**	**Q46. Meets program standard (>4) for 2002.** **KU -0.19 compared to Select 6.** **Negative trend noted.** **Q46. Meets program standard (>4) for 2001.** **KU -0.34 compared to Select 6.** **Negative trend noted.** **Q46. Meets program standard (>4) for 2000.** **KU +0.47 compared to Select 6.** **Positive trend noted.**	**In 2000, 2001 and 2002 the results appear to exceed the standard.** **Thus no action is recommended.**

PROGRAM OUTCOME **(h):** ***(continued)***

Assessment Method and Standards	Assessment Results	Conclusions	Action Taken
2. <u>Senior thesis project</u> (Data is for respondents who are in the BEE degree program.) **These surveys assess the student's academic preparation and how their co-op work experience has contributed to the Senior Thesis Project.** ***<u>Survey of EE students</u>:*** **Q8 – Provided the broad education necessary for you to understand the impact of engineering solutions in a global and societal context.**	**<u>March 2003:</u>** **<u>Q8:</u>** **65 out of 70 responses (93%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Survey of faculty advisors:</u> **Q8 – Demonstrated broad education necessary to understand impact of engineering solutions in a global and societal context.**	**<u>March 2003:</u>** **<u>Q8:</u>** **33 out of 33 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Survey of employer advisors:</u> **Q8 – Demonstrated broad education necessary to understand impact of engineering solutions in a global and societal context.** ***<u>Standard:</u>*** **It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or Strongly Agree" in this survey.**	**<u>March 2003:</u>** **<u>Q8:</u>** **58 out of 58 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**

PROGRAM OUTCOME (h): ***(continued)***

Assessment Method and Standards	Assessment Results	Conclusions	Action Taken
3. <u>Co-op program work</u> (Data is for respondents who are in the BEE degree program.) ***<u>Survey of EE students:</u>*** **Evaluation of Academic Preparation from KU for your Co-op Work Term: Q8-Broad education necessary to understand the impact of engineering solutions in a global and societal context.**	**<u>March 2003:</u> <u>Q8:</u> 192 out of 230responses (84%) "Agree" or "Strongly Agree."**	**Not satisfactory based on the data available. However, the survey result is just 1%below the standard.**	**Monitor this data continuously to see its trend in the future years.**
Assess how this cooperative education experience has contributed to your overall education: **Q8-Broad education necessary to understand the impact of engineering solutions in a global and societal context.**	**<u>March 2003:</u> <u>Q8:</u> 281 out of 292 responses (96%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Survey of co-op supervisors:</u> **Assess the student's academic preparation for cooperative education assignment: Q6- Demonstrated broad education necessary to understand the impact of engineering solutions in a global and societal context.**	**<u>March 2003:</u> <u>Q6:</u> 145 out of 148 responses (98%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Standard:</u> **It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or "Strongly Agree" in this survey.**			

Table 3.11 ***PROGRAM OUTCOME*** **(i):**

an appreciation for the need for, and preparedness to engage in life-long learning

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
<u>1. EBI survey</u> **Q52. To what degree did your engineering education enhance your ability to recognize the need to engage in lifelong learning?** **(In 2002 EBI, these questions were renumbered as Q51.)** **(7 point scale, 7=extremely, 4=moderately, 1=not at all)** ***<u>Standard:</u>*** **Rating in the extremely-moderately range (>4), > Select 6 rating, and positive trend over 3 years.**	**2002** **Q51. KU: 5.12** **Select 6: 5.45** **2001** **Q52. KU: 6.00** **Select 6: 5.29** **2000** **Q52. KU: 5.63** **Select 6: 5.43**	**Q51. Meets program standard (>4) for 2002.** **KU -0.34 compared to Select 6.** **Negative trend noted.** **Q52. Meets program standard (>4) for 2001.** **KU 0.71 compared to Select 6.** **Positive trend noted.** **Q46. Meets program standard (>4) for 2000.** **KU +0.20 compared to Select 6. Positive trend noted.**	**In 2000, 2001 and 2002 the results appear to exceed the standard.** **Thus no action is recommended.**

PROGRAM OUTCOME (i): ***(continued)***

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
2. <u>Senior thesis project</u> **(Data is for respondents who are in the BEE degree program.)** **These surveys assess the student's academic preparation and how their co-op work experience has contributed to the Senior Thesis Project.** ***<u>Survey of EE students</u>:*** **Q9 – Developed your recognition of the need for life-long learning and developed your ability to engage in it.**	**<u>March 2003:</u>** **<u>Q9:</u>** **65 out of 70 responses (93%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Survey of faculty advisors:</u> **Q9- Recognized the need for and demonstrated the ability to engage in life-long learning.**	**<u>March 2003:</u>** **<u>Q9:</u>** **29 out of 29 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Survey of employer advisors:</u> **Q9- Recognized the need for and demonstrated the ability to engage in life-long learning.**	**<u>March 2003:</u>** **<u>Q9:</u>** **60 out of 60 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Standard:</u> **It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or Strongly Agree" in this survey.**			

PROGRAM OUTCOME (i): ***(continued)***

Assessment Method and Standards	**Assessment Results**	**Conclusions**	**Actions Taken**
3. <u>Co-op program work</u> (Data is for respondents who are in the BEE degree program.) ***<u>Survey of EE students:</u>*** **Evaluation of Academic Preparation from KU for your Co-op Work Term: Q9-Recognition of the need for and ability to engage in life-long learning.**	**<u>Feb. 2003:</u>** **<u>Q9:</u>** **177 out of 191 responses (93%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
Assess how this cooperative education experience has contributed to your overall education: Q9-Recognition of the need for and ability to engage in life-long learning. ***<u>Standard:</u>*** **It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or "Strongly Agree" in this survey.**	**<u>Feb. 2003:</u>** **213 out of 220 responses (97%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**

Table 3.12 ***PROGRAM OUTCOME*** **(j):**

knowledge of contemporary social, economical and political issues and their impact on engineering profession

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
<u>1.Evaluation of a paper prepared by each student addressing issues of *"Social Sciences".*</u> **This paper is assessed by Liberal Studies Department at KU** **Assessment items relevant to this program outcome are:** **8. Displays an understanding of contemporary issues.** **9.Displays an ability to interpret and analyze contemporary issues using social scientific methods.** **10. Displays an understanding of international contemporary issues.** **17. Displays an ability to relate contemporary issues to professional practice.** ***<u>Standard:</u>*** **It is expected an average grade >2 out of 4 to these items as set by the Liberal Studies Department.**	**Summer 2002 - Winter 2003:** **Average: 2.11**	**The average of the standard test given by the Department of Liberal Studies is (>2) meeting the program standard.**	**No action is required.**

PROGRAM OUTCOME **(j):** ***(continued)***

Assessment Method and Standards	**Assessment Results**	**Conclusions**	**Actions Taken**
<u>2. EBI survey</u> **Q57. To what degree did your engineering education enhance your ability to understand contemporary issues?** **(In 2000 and 2001 EBI, these questions were not available.)** **(7 point scale, 7=extremely, 4=moderately, 1=not at all)** ***<u>Standard:</u>*** **Rating in the extremely-moderately range (>4), > Select 6 rating, and positive trend over 3 years.**	**<u>2002</u>** **Q57. KU: 4.74** **Select 6: 4.99**	**Q57. Meets program standard (>4) for 2002.** **KU -0.25 compared to Select 6.** **Negative trend noted.**	**Data indicates that no action is required.**

PROGRAM OUTCOME **(j):** ***(continued)***

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
3. <u>Senior thesis project</u> (Data is for respondents who are in the BEE degree program.) These surveys assess the student's academic preparation and how their co-op work experience has contributed to the Senior Thesis Project.			
<u>Survey of EE students</u>: **Q10 – Developed your knowledge of contemporary issues.**	**<u>March 2003:</u> <u>Q10:</u> 65 out of 70 responses (93%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Survey of faculty advisors:</u> **Q10 – Demonstrated knowledge of contemporary issues.**	**<u>March 2003:</u> <u>Q10:</u> 23 out of 26 responses (88%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Survey of employer advisors:</u> **Q10 –Demonstrated knowledge of contemporary issues.** ***<u>Standard:</u>*** **It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or Strongly Agree" in this survey.**	**<u>March 2003:</u> <u>Q10:</u> 57 out of 58 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**

PROGRAM OUTCOME **(j):** ***(continued)***

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
4. <u>Co-op program work</u> (Data is for respondents who are in the BEE degree program.) ***<u>Survey of EE students:</u>*** **Evaluation of Academic Preparation from KU for your Co-op Work Term:** **Q10 –Knowledge of contemporary issues.**	**<u>March 2003:</u>** **<u>Q10:</u>** **202 out of 239 responses (85%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
Assess how this cooperative education experience has contributed to your overall education: **Q10 –Knowledge of contemporary issues.**	**<u>March 2003:</u>** **<u>Q10:</u>** **286 out of 303 responses (94%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required.**
<u>Standard:</u> **It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or "Strongly Agree" in this survey.**			

Table 3.13 ***PROGRAM OUTCOME*** **(k):**

an ability and experience in using the techniques, skills, and modern engineering tools necessary for engineering practice

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
1.Senior Design Project portfolio **(evaluation by EE Senior Design Assessment Committee)** **Assessment of Student Work: Item 8 rating. Item 8: Use modern engineering tools (e.g. development systems, laboratory test equipment, software packages, etc.).** **Evaluated on 5 point scale, 5= excellent, 3=satisfactory, 1= needs improvement.** **Standard: Rating in the excellent – satisfactory range (>3).**	**Item 8 rating:** ***Summer 2001:*** **Excellent** **Spring 2002:** **Excellent** **Summer 2002:** **Excellent-satisfactory** **Fall 2002:** **Satisfactory**	**Item 7 rating have been in the excellent-satisfactory range (>3) for the past 4 terms meeting the program standard.**	**No action is required.**

PROGRAM OUTCOME **(k):** ***(continued)***

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
2. <u>EBI Surveys</u> **Q14. How do you rate your satisfaction with the engineering curriculum instructors' presentation of technology issues?** **Q27. How do you rate your satisfaction with the availability of computers in the Engineering School?** **Q28. How do you rate your satisfaction with the remote access to the computer network at your Engineering School?** **Q29. How do you rate your satisfaction with the training to utilize the computing resources at your Engineering School?** **Q46. To what degree did your engineering education enhance your ability to use modern engineering tools?** **Q71. To what degree did the laboratory facilities allow you to use modern engineering tools?** **(7 point scale, 7=extremely, 4=moderately, 1=not at all)**	**2002** **Q14. KU: 4.96** **Select 6: 5.13** **Q27. KU 5.40** **Select 6: 5.65** **Q28. KU 4.38** **Select 6: 5.20** **Q29. KU 4.27** **Select 6: 4.35** **Q46. KU 5.08** **Select 6: 5.37** **Q71. KU 4.85** **Select 6: 5.19** **2001** **Q14. KU: 5.00** **Q27. KU: 5.60** **Q28. KU: 5.20** **Q29. KU: 3.20** **Q46. KU: 4.60** **Q71. KU: 4.60** **2000** **Q14. KU: 4.81** **Q27. KU: 5.33** **Q28. KU: 5.13**	**Q14. Meets program standard (>4) for 2002. KU -0.17 compared to Select 6.** **No clear trend.** **Q27. Meets program standard (>4) for 2002. KU -0.25 compared to Select 6.** **No clear trend.** **Q28. Meets program standard (>4) for 2002. KU -0.82 compared to Select 6.** **Negative trend noted.** **Q29. Meets program standard (>4) for 2002. KU -0.08 compared to Select 6.** **No clear trend.** **Q46. Meets program standard (>4) for 2002. KU -0.29 compared to Select 6.** **No clear trend.** **Q71. Meets program standard (>4) for 2002. KU -0.34 compared to Select 6. Slight positive trend noted.**	**KU is below the Select 6 average for all of these items. The reason is unclear at this time.** **Q14, Q27, Q29, Q46, Q71 indicate that no action is required. Monitor trend for 2003.** **Q28 indicates that action is required. Recommend to Academic Computing Committee and KU Computer Center that remote access to KU computers become more available.**

PROGRAM OUTCOME **(k):** ***(continued)***

Assessment Method and Standards	**Assessment Results**	**Conclusions**	**Actions Taken**
3. <u>Senior thesis project</u> (Data is for respondents who are in the BEE degree program.) ***<u>Survey of EE students:</u>*** **Evaluation of Academic Preparation from KU for the Senior Thesis Project: Q11 – Developed your ability to use the techniques, skills and modern engineering tools necessary for engineering practice.**	**<u>March 2003:</u> 65 out of 70 responses (93%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required, however, it is recommended that the data be differentiated by degree program for future assessment.**
<u>Survey of faculty advisors:</u> **Assess the student's academic preparation and how their co-op work experience has contributed to the Senior Thesis Project: Q11 – Demonstrated ability to use the techniques, skills and modern engineering tools necessary for engineering practice.**	**<u>March 2003:</u> 38 out of 38 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required, however, it is recommended that the data be differentiated by degree program for future assessment.**
<u>Survey of employer advisors:</u> **Assess the student's academic preparation and how their co-op work experience has contributed to the Senior Thesis Project: Q11 – Demonstrated the ability to use the techniques, skills and modern engineering tools necessary for engineering practice.** ***<u>Standard:</u>*** **It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or "Strongly Agree" in the surveys of items 3 and 4, above.**	**<u>March 2003:</u> 65 out of 65 responses (100%) "Agree" or "Strongly Agree."**	**Satisfactory based on the data available. Meets program standards.**	**Data indicates that no action is required, however, it is recommended that the data be differentiated by degree program for future assessment.**

PROGRAM OUTCOME (k): *(continued)*

Assessment Method and Standards	Assessment Results	Conclusions	Actions Taken
4. <u>Co-op program work</u> **(Data is for respondents who are in the BEE degree program.)** ***<u>Survey of EE students:</u>*** **Evaluation of Academic Preparation from KU for your Co-op Work Term: Q3 – Ability to design a system, component or process to meet desired needs.**	**<u>Feb. 2003:</u>** **139 out of 196 responses (71%) "Agree" or "Strongly Agree."**	**Not satisfactory based on the data available. Does not meet program standards, however, conclusions are based on co-op experience at all degree levels, freshman through senior.**	**Data indicates that action is required. It is recommended that Q3 of this survey be administered to seniors only for future assessment.**
Assess how this cooperative education experience has contributed to your overall education: Q3 - Ability to design a system, component or process to meet desired needs.	**<u>Feb. 2003:</u>** **193 out of 254 responses (76%) "Agree" or "Strongly Agree."**	**Not satisfactory based on the data available. Does not meet program standards, however, conclusions are based on co-op experience at all degree levels, freshman through senior.**	**Data indicates that action is required. It is recommended that Q3 of this survey be administered to seniors only for future assessment.**
<u>Survey of co-op supervisors:</u> **Assess the student's academic preparation for cooperative education assignment: Q3 – Demonstrated the ability to design a system, component or process to meet desired needs.** ***<u>Standard:</u>*** **It is expected to have 85% of the respondents for the electrical engineering program indicate "Agree" or "Strongly Agree" in the surveys of items 3 and 4, above.**	**<u>Feb. 2003:</u>** **156 out of 190 responses (82%) "Agree" or "Strongly Agree."**	**Not satisfactory based on the data available. Does not meet program standards, however, conclusions are based on co-op experience at all degree levels, i.e freshman through senior.**	**Data indicates that action is required. It is recommended that Q3 of this survey be administered to seniors only for future assessment.**

Table 3. 14 ***PROGRAM OUTCOME*** **(l)**:

a knowledge of computer science and computer engineering, and engineering sciences necessary to analyze and design systems containing hardware and software components

Assessment Method and Standards	Assessment Results	Conclusions	Actions taken
1. <u>Common final exams for the required CE and CS courses in EE program</u> ***Standard:*** It is expected to have an average of 80% or higher in the above tests.	1. <u>CE 210 Digital Systems I</u> Number of students attempting the test: 109 <u>Average</u> Fall 2001 : 63.4% Winter 2002: 56.4% Spring 2002: 60.5% Summer 2002: 61.8%	Major difficulty with students learning was on Karnaugh maps and number system conversions.	The amount of teaching time was increased for Karnaugh maps, only a modest improvement was observed in student performance. Moreover, a series of standard tutorial/practice materials will be developed to offer to students in all sections of CE-210. They will address course learning objectives on which students have scored poorly, and be developed in priority order as time allows. The first installment, in Summer 2003, will be on Karnaugh maps.
		It was the consensus reached by the EE faculty that this program outcome could not be achieved strongly after demonstrating the new curriculum for one year mainly due to not having sufficient depth in hardware components.	In order to achieve this program outcome, EE faculty decided a required course in the area of Microcomputers for all the students in the EE Program. Monitor the trend.

4. Professional Component

Consistent with the Program Educational Objectives and the mission of the Kettering University, the curriculum of the Electrical Engineering Program is comprised of three major components, namely, mathematics and basic sciences, engineering sciences and engineering design, and finally a general education component that complements the technical content of the program. These three components are developed in such a way that after the students complete all the basic courses, they are all prepared to undertake a senior design project on campus. In addition, all students are required to complete a senior thesis, which may have a major design component at their co-op company as the culmination of the education they have received at Kettering University. A student graduating with the degree of Bachelor of Science in Electrical Engineering must complete a total of 160 credits of course work in all the above-mentioned areas, which is equivalent to four years or eight terms at a load of 20 hours per term[1]. For a typical student, usually it takes nine terms to complete all the degree requirements. However, in some cases, a student may complete all the degree requirements in eight terms or ten terms, and very seldom in eleven terms.

4.1 Mathematics and Basic Sciences

Each student seeking the degree of Bachelor of Science in Electrical Engineering at Kettering University must complete 40 credits (10 courses) of a combination of mathematics and basic science courses (equivalent to one year) in order to comply with the EAC as well as IEEE requirements. Nine of these courses are MATH-101, Calculus I; MATH-102, Calculus II; MATH-203, Multivariate Calculus; MATH-307, Matrix Algebra; MATH-204, Differential Equations and Laplace Transforms; MATH-408, Probability and Statistics; PHYS-114, Newtonian Mechanics; PHYS-224, Electricity and Magnetism; and CHEM-135, Principles of Chemistry. Moreover, students are required to take one science elective from a pool of courses in order to enhance their knowledge in the area of science. These courses are listed in Table I-1 (Appendix I.A) in the order in which they are given in the curriculum. Moreover, in Appendix I.B, standard descriptions for these courses are presented in the form of course syllabi. A representative program, including the sequence of courses in Mathematics and Basic Sciences is shown in Table 4.1.

4.2 Engineering Sciences and Engineering Design

For the degree of Bachelor of Science in Electrical Engineering at Kettering University, every student must complete 72 credits (1.8 years) of course work in the area of engineering science and engineering design. Out of 72 credits 40 of them are obtained from courses, that are required for all students in the Electrical Engineering Program. The remaining 32 credits are gained in a variety of engineering electives: 24 credits (6 courses) of electrical engineering electives; 4 credits (1 course) in an electrical or computer engineering course, and 4 credits (1 course) in an area of engineering outside of electrical engineering.

The ten required engineering courses in the Electrical Engineering Program are, MFGG-135, Interdisciplinary Design and Manufacturing; MECH-210, Mechanics I; EE-210, Circuits I; EE-310, Circuits II; EE-230, Signals and Systems; EE-240, Electromagnetic Fields I; EE-320,

[1] One academic term is defined as eleven weeks of course work including one day of reading and 2.5 days of final learning experience at the end.

Electronics I; CE-210, Digital Systems I; CE-320, Microcomputers I and EE-490, Senior Electrical Engineering Design Project.

In order to give depth in the area of analysis and design of hardware and software components Microcomputers I has been included as a required course for all the electrical engineering students since the summer of 2002.

Additionally, the program has a computer science course, entitled "Computing and Algorithms" taught by the faculty of the Computer Science Program of the Department of Science and Mathematics.

Students in the Electrical Engineering Program are exposed to design early in their education (Freshman Year) at Kettering with the course MFGG 135, Interdisciplinary Design and Manufacturing. During their education in the Electrical Engineering Program, students continue to having exposure to design in many of the required and elective electrical engineering courses, such as EE 320, Electronics and CE 320, Microcomputers just to name a few. Ultimately, each student in the Electrical Engineering Program must take a course entitled, "Senior Electrical Engineering Design", when they are prepared, during their senior year at Kettering. In this major design experience, students have the opportunity of applying such important considerations as manufacturability, environmental, economic, ethical, social, engineering standards and safety to their design projects. In the notebook of Program Outcome (c) (Program Outcome Notebooks for the Electrical Engineering Program will be available at the time of the campus visit) there are samples of student work for this major design experience. Furthermore, Kettering University requires that each student complete a senior thesis project addressing a work-related problem, such as design of a product, improvement of a system etc. Students typically spend two-work terms to finish the thesis under the supervision of a faculty advisor as well as an employer advisor. Some of these projects provide a significant design experience to the students.

A list of all the courses related to the engineering sciences and engineering design are presented in Table I-1 (Appendix I.A) in the order in which they are given in the electrical engineering curriculum. Moreover, in Appendix I.B, standard descriptions for these courses are given in the form of course syllabi. In Table 4.2, Electrical Engineering Program Requirements are shown.

4.3 General Education

The technical content of the Electrical Engineering Program is complemented by a general education component in order to achieve the Program Outcomes. Thus every student in this program must complete 40 credits of general education courses (equivalent to one year). The basic courses in the general education component are HUMN-201, Introduction to Humanities; SSCI-201, Introduction to Social Science; COMM-101, Written and Oral Communications I and ECON-201, Economic Principles. In order to give depth in this component, students are required to complete at least four more advanced level courses (300 level or above), namely, COMM-301, Written and Oral Communications II; LS-489, Senior Seminar, an advanced elective Humanities course and an advanced elective Social Science course, which can be selected from a variety of Humanities and Social Science elective courses.

All of these courses are listed in Table I-1 in the order in which they are given in the curriculum. Moreover, in Appendix I.B, standard descriptions for these courses are presented in the form of course syllabi. A representative program, including the sequence of courses in General Education is shown in Table 4.1.

Table 4.1 A nine-term representative Electrical Engineering Program

EE Representative Program
(Nine Terms)

FR-I (Summer/Fall)	Written & Oral Communication I (COMM-101)	Calculus I (MATH-101)	Principles of Chemistry (CHEM-135)	Interdisciplinary. Design & Manufacturing (MfGG-135)	
FR-II (Winter/Spring)	Introduction to Humanities (HUMN-201)	Calculus II (MATH -102)	Newtonian Mechanics (PHYS -114)	Computing & Algorithms I (CPSC-101)	
SO-I (Summer/Fall)	Introduction to Social Sciences (SSCI-201)	Multivariate Calculus (MATH -203)	Electricity & Magnetism (PHYS-224)	Mechanics I (ME-210)	
S0-II (Winter/Spring)	Economic Principles (ECON-201)	Differential Equations & Laplace Transforms (MATH -204)	Digitals I (CE -210)	Circuits I (EE-210)	
JR-I (Summer/Fall)	Written & Oral Communication II (COMM-301)	Matrix Algebra (MATH -307)	Circuits Ii (EE -310)	Signals & Systems (EE -230)	
JR-II (Winter/Spring)	Science Elective	Probability & Statistics (MATH -408)	Electromagnetic Fields & Applications (EE-240)	Electronics I (EE-320)	Engineering Elective
SR-I (Summer/Fall)	Advanced Humanities Elective	Microcomputers I (CE-320)	EE Elective	EE Elective	EE Elective
SR-II (Winter/Spring)	Advanced Social Science Elective	EE Elective	EE Elective	EE Elective	Free Elective
SR-III (Summer/Fall)	Senior Seminar (LS-489)	EE or CE Elective	Senior Project (EE-490)	Free Elective	

Summer/Fall Electives : EE-325, EE-346, EE-348, EE-428, EE-430, EE-432, EE-444,EE-490(core) EE-520, EE-582
Winter/Spring Electives : EE-330, EE-340,EE-342, EE-344,EE-420, EE-424, EE-426, EE-530, EE-580, EE-584

Table 4.2 Electrical Engineering Program requirements.

EE Program Requirements
Electrical & Computer Engineering Coursers

EE & CE 200 level courses	EE & CE 300 level courses	EE 400 level courses	EE 500 level courses
EE-210 Circuits I *(core)*	**EE-310 Circuits II** *(core)*	**EE-420 Electronics II** *(elective)*	**EE-520 Electronic Circuits& sys** *(elective)*
EE-230 Signals & Systems *(core)*	**EE-320 Electronics I** *(core)*	**EE-424 Power Electronics** *(elective)*	**EE-530 Digital Control Systems** *(elective)*
EE-240 Electromagnetic Fields *(core)*	**CE 320 Microcomputers** *(core)*	**EE-426 Solid State Devices** *(elective)*	**EE-580 Automotive Electronics** *(elective)*
CE 210 Digitals I *(core)*	**EE-325 Principles of Microelectronic Processing** *(elective)*	**EE-428 VLSI Design** *(elective)*	**EE-582 Robot Dynamics** *(elective)*
	EE-330 Digital Signal Processing *(elective)*	**EE-430 Communication Systems** *(elective)*	**EE-584 Wireless Communications** *(elective)*
	EE-340 Electro- magnetic Wave propagation *(elective)*	**EE-432 Feedback Controls** *(elective)*	
	EE-342 Electric Machines *(elective)*	**EE-444 Computational Methods in Power Systems** *(elective)*	
	EE-344 Fundamentals of Power Systems *(elective)*	**EE-490 Senior Design Project** *(elective)*	
	EE-346 High Voltage Gen. & Measurement Tech. *(elective)*	**EE-499 Independent Study** *(elective)*	
	EE-348 Electro-magnetic Compatibility *(elective)*		

EE-CE Requirements : 15 (EE+CE) courses (37.5%)
6 EE core courses, 2 CE core course + 6 EE electives + 1 EE or CE elective

Other Engineering Courses :
ME : ME-210 (2.5%)
MFGE : MFGE-135 (2.5%)
Engineering elective : Any non-EE engineering course (2.5%)

Non-Engineering :
PROGRAM : CPSC-101 (2.5%)
MATH : MATH-101, -102, -203, -204, -307, -408 (15%)
SCIENCE : CHEM-135, PHYS-112, -222 + A Science Elective (10%)
GENERAL.EDUCATION : COMM-101, HUMN-201,SSCI-201,ECON-201,COMM-301
Adv. HUMN Elect. , Adv. SSCI Elect., LS-489 (20%)
ADDITIONAL : 2 Free Electives (5%)
THESIS : (2.5%)

5. Faculty

The size and qualifications of the faculty in the Electrical Engineering program are analyzed in the following sections to illustrate that Criterion 5 is satisfied. The information contained in Table I-3, Table I-4 and the curriculum vitae of the faculty members, provides supporting documentation for the faculty size, workload and faculty qualifications.

5.1 Faculty Size

During the 2002-2003 academic year, the electrical engineering program faculty consisted of 13 full-time tenured faculty members and one full-time visiting professor, whose contract expires in June 2003. Seven of the faculty members are full professors and the remaining six are associate professors.

Under a normal full-time appointment, a faculty member is required to teach for 3 out of 4 terms each academic year. This results in an average of 10 full-time faculty members available in each term. The current faculty size yields a student-to-faculty ratio of 18 in the Electrical Engineering Program.

The teaching contact hours of a faculty member are typically 9-12 hours each term. Ten faculty members are on a three-terms-per-year teaching contract, and four faculty members are on a seven-eighth or seven-terms-per-two-years teaching contract. Table 5.1 shows the faculty teaching workload summary for the year 2002-2003.

Table 5.1 Faculty teaching workload summary for the year 2002-2003 in units of term-contact hours.

Faculty member	Teaching	Other	Total	Expected
M. Elta *(visiting professor)*	31	0	31	27-36
C. Finelli	12	24	36	27-36
J. Gover	31	0	31	27-36
B. Guru	42	0	42	36-48
H. Hiziroglu	28	6	34	27-36
K. Kaiser	31	0	31	27-36
D. Leffen	30	0	30	27-36
J. McLaughlin	36	0	36	36-48
D. Melton	31	0	31	27-36
K. Palmer	31	0	31	27-36
L. Rust	29	0	29	27-36
M. Thompson	29	0	29	27-36
M. Torfeh	43	0	43	36-48
R. Warrier	23	12	35	27-36
Total	427	42	469	405-540

Table 5.1 illustrates that the faculty workload for the year 2002-2003 remained within the expected range. The numbers in the *"other"* column are explained as:

(a) Two-thirds of the workload for C. Finelli was to discharge her duties as the director for Center of Excellence in Teaching and Learning.
(b) As the leader of the program assessment, H.Hiziroglu had six hours of reduced teaching load to organize and prepare the assessment documentation.
(c) One-third of R.Warrier's workload represents the administrative responsibilities as the program director of the electrical engineering program.

Advising:

In addition to teaching, faculty members also serve as senior thesis advisors to students. The average number of thesis students assigned to each faculty per year is six. The number of hours that a faculty spends as thesis advisor for a student is typically 20 hours per year.

The faculty responsibilities include student advising. Every faculty member advises students assigned to him/her on course selections for the succeeding academic term. Two of the faculty members in the Electrical Engineering Program advise students on the Study Abroad Program. In addition to academic advising, the faculty members also advise a number of students on their senior thesis projects. The faculty advisor works closely with the student in order to ensure a timely completion of a satisfactory thesis project.

Service:

The faculty members of the Electrical Engineering Program serve in various university committees and departmental committees. There is at least one electrical engineering faculty representative on each university standing committee. One faculty member served as the Director of the Center for Excellence in Teaching and Learning (CETL) from 2001 to 2003.

Seven faculty members serve in the curriculum committee of the Electrical Engineering Program, which meets about four times every term. Volunteers among the faculty also participate in the University Open House and Discover Kettering programs. Three electrical engineering faculty members served as mentors to high school students who participated at the First Robotic Competition in Ann Arbor, Michigan.

Professional Development:

The professional development activities of electrical engineering faculty involve attending technical conferences and presenting research papers, attending several technical workshops, developing courses on cutting-edge technologies, and writing proposals for research and equipment grants for the laboratories.

Interaction with Industry:

The electrical engineering faculty members interact with industries in different ways. Many continuing education and training programs were developed based on the needs of companies like General Motors, Delphi and Bosch. Seven faculty members have conducted training programs for practicing engineers at the training centers of the above-mentioned companies.

As the faculty advisor for students on their senior thesis projects, every faculty member interacts with students' employers to ensure that the students have the requisite educational background and skills to conduct their theses that they meet with the industrial standards, and that the theses are completed on time.

The Industry Advisory Board (IAB) for the ECE Department meets with the faculty at least once every year. In these meetings, the electrical engineering faculty members discuss with IAB issues pertinent to improving the electrical engineering program .

5.2 Faculty Competence

All faculty members of the Electrical Engineering Program are competent to teach the five electrical engineering core courses. Table 5.2 shows the number of faculty members who regularly teach the core courses.

Table 5.2 The number of faculty members who regularly teach the core courses.

Core course	Number of faculty who teach the course
EE-210, Circuits I	11
EE-230, Signals &Systems	5
EE-240, Electromagnetic Fields & Applications	5
EE-310, Circuits II	6
EE-320, Electronics I	6

The electrical engineering electives are in the areas of control systems, electrical machines electromagnetics, electronics, high-voltage systems, power systems, semiconductors, and signal processing and communications. Table 5.3 shows the number of faculty members who teach in each elective area.

Table 5.3 The number of faculty members who teach in elective course areas.

Electives	Number of faculty members who teach the course
Control systems	4
Electrical machines	3
Electromagnetics	3
Electronics	5
High voltage systems	1
Power systems	1
Semiconductors	2
Signal processing and communications	4

Education and background:

Out of fifteen faculty members of the Electrical Engineering Program, fourteen have doctoral degrees in engineering and one has a master of science degree in engineering, a degree in law and is also a registered professional engineer in the state of Michigan. The diversity of faculty background is demonstrated by the elective areas they teach as shown in Table 5.3.

Industrial and teaching experiences:

Eight faculty members worked in industry before joining the faculty of electrical engineering. The teaching experience of electrical engineering faculty ranges from 4 to 40 years. Some of the faculty members have had teaching experience at other universities before joining Kettering University.

Ability to communicate:

Kettering University emphasizes ability to communicate in English as an important criterion in faculty hiring. A candidate for a position as a faculty member is required to give an oral presentation to the faculty in addition to a one-on-one interview. The communication abilities of faculty members are also monitored by student evaluations.

Enthusiasm for developing an effective program:

The members of the electrical engineering faculty constantly try innovative methods to enhance the effectiveness of the program. Some of the examples of faculty initiatives in this direction are listed below:

(a) Electronic delivery of class notes and problem sets using Blackboard and other internet means, and using internet communication as an additional tool to help students,
(b) effective use of multimedia tools in the class-room environment,
(c) encouraging team activities in class room
(d) preparing class notes and problem sets
(e) posting faculty calendars so that the students can have effective access to faculty
(f) attending and conducting workshops on effective teaching organized by the Center for Excellence in Teaching and Learning (CETL).

Scholarship and participation in professional societies:

Two of the faculty members of the Electrical Engineering Program have published textbooks in the areas of electrical machines and electromagnetic fields. These books have not only been widely adopted by the universities in the United States as well as in foreign countries, but have also been translated into Chinese and Korean. Two faculty members are currently writing books on electric circuits and electromagnetic principles.

Some of the members of the electrical engineering faculty are members of IEEE and/or ASEE. One of the faculty members in the Electrical Engineering Program is a Fellow of IEEE while another one is a senior member of IEEE.

6. Facilities

The facilities available to the electrical engineering program are, on the whole, adequate to accomplish the program objectives and provide an atmosphere conducive to learning. The university provides access to adequate classroom facilities and computing and information infrastructure. The Department of Electrical and Computer Engineering maintains several of its own laboratories to support its courses, including several used primarily by the electrical engineering program. Classroom, computing and information infrastructure, and individual Department of Electrical and Computer Engineering laboratories are each discussed separately in the paragraphs that follow.

6.1 Classrooms:

There are approximately 50 classrooms in Kettering's Academic Building, with capacities ranging from a couple of dozen to more than a hundred students. Availability of adequate classroom space for the electrical engineering program has never been a problem.

The conditions of the classrooms vary, ranging from fairly old to freshly renovated, bright, and comfortable. The university is presently engaged in a program that aims to renovate all classrooms over the next couple of years. At least 15 have already been renovated under this program.

Network connectivity and multimedia capabilities are being added to many classrooms as they are renovated. Approximately four now have wired network connections and computer projection systems. Many additional classrooms have wireless Internet access. Scheduling classrooms with appropriate capabilities for electrical engineering courses has never been a problem.

6.2 Computing and Information Infrastructure

The University's Information Technology Department maintains extensive general-purpose computational resources for students. There are four computer laboratories with a total of approximately 120 modern PC workstations available for student use. The workstations run the Microsoft Windows NT 4.0 operating system, and offer software tools including MS Office 98, Netscape, Minitab, Ideas 8, Matlab, Borland TASM, Solid Edge VII, sSnap, Microsoft Visual Basic, and Mathcad Plus8. There are also four UNIX workstation laboratories with a total of approximately 60 Sun Microsystems workstations operated by the Information Technology Department in conjunction with academic departments. Some of these that are particularly important to the electrical engineering program are described in more detail below. All students and faculty have university-provided accounts that allow them access to all Windows and UNIX workstations.

Internet access is extensive. All computer laboratories, faculty offices, and rooms in the student residence hall have network access, as do a growing number of classrooms and other laboratories. The campus network is in the process of being upgraded from an ATM backbone to a Cisco Gigabit backbone for all computer labs, offices, and student living spaces. A campus wireless network is also being implemented. As of January 2003, access is available in the Library, Campus Center Great Court, and Sunrise and Sunset rooms. When finished in 2004, all classrooms, labs and common areas of the university will have wireless access. All students and faculty have full e-mail service through their university-provided accounts. There is a caching web proxy server for the campus and and web e-mail access.

Blackboard e-Education software is available and widely used. A Blackboard "course" is automatically created for every actual course offered on campus. This allows instructors to easily post course materials and grades, offer quizzes and assessment surveys, and communicate via e-mail and chat with all students in their classes. Other organizations such as the academic departments, the Faculty Senate, and various student organizations have their own Blackboard "communities", which offer the same capabilities as courses.

Computing and information infrastructure are more than adequate for the needs of the electrical engineering program.

6.3 Department Laboratories

Laboratories maintained by the Department of Electrical and Computer Engineering, and the opportunities that they provide students to use modern engineering tools, are described individually in the paragraphs that follow. They are, on the whole, more than adequate for the needs of the electrical engineering program. However, there is ongoing pressure for additional space for new laboratories for which there is funding, but no suitable space. For example, the program currently has funding to develop a Digital Systems Laboratory and a Logic Systems for Manufacturing Laboratory, but only one suitable laboratory space is available. Also, the Computer Networks and Computer Engineering Senior Design Laboratories are without good homes, although they can operate as needed.

This problem is not uncommon: "turf" is always at a premium in universities. Moreover, there is good reason to expect improvement in the next one or two years. The university's new Mechanical Engineering and Chemistry building is on track to open during the Summer 2003 term, and this should allow substantial additional space in the Academic Building to be made available for the electrical engineering program in the following year or two.

Circuits Laboratory:

This laboratory includes six student stations, each accommodating two or some times three students. Each station includes:

- Tektronix TDS 420A digitizing oscilloscope; 4-channel, 200-MHz bandwidth, floppy disk for data storage
- Kenwood FG-273 function generator
- Tektronix PS 280 triple-output DC power supply

The Circuits Laboratory offers students the opportunity to use modern engineering tools in the following course:

- EE-211 *Circuits I Laboratory* – The oscilloscope and function generator, and power supply are used in a series of exercises that include basic voltage, current, resistance, and impedance measurements.

Electronics Laboratory:

This laboratory includes 12 student stations, each normally accommodating two students. Each station includes:

- Tektronix TDS 430A digitizing oscilloscope; 2-channel, 400-MHz bandwidth, floppy disk for data storage
- Philips PM5131 2-MHz function generator
- Tektronix CFG 280 11-MHz function generator
- Fluke 8050A digital multimeter
- Two HP6267B single-output DC power supply

Additional laboratory equipment includes:

- Two Dell Optiplex GXi computer workstations and one HP LaserJet 5M network printer for printing oscilloscope trace data
- Sencore LC53 capacitance-inductance analyzer

The Electronics Laboratory offers students the opportunity to use modern engineering tools in the following courses:

- EE-321 *Electronics I Laboratory*– The oscilloscope, function generator, digital multimeter, and power supply are used in series of projects that include the design, implementation and debugging of operational amplifier, diode, BJT and MOSFET circuits.

- EE-420 *Electronics II* – The oscilloscope, function generator, digital multimeter, and power supply are used in series of projects that include the design, implementation and debugging of multistage, differential and power amplifiers as well as active filters, comparator, Schimitt-trigger and 555-timer circuits.

- MFGG-135 *Interdisciplinary Design and Manufacturing* – The oscilloscope, function generator, digital multimeter, and power supply are used (with considerable supervision) in guiding freshmen through the construction and testing of PWM driver boards for the leg actuators of a "walking bug" robot.

Control Systems Laboratory:

This laboratory includes six student stations, each normally accommodating two students. Each station includes:

- Micron 80486 computer workstation; 66 MHz, 32 MB memory, 400 MB disk, 15-inch monitor, National Instruments analog input/output board
- Tektronix 2211 digital storage oscilloscope
- TENMA 2-MHz function generator
- Reliance Electrocraft E586 DC servomotor
- Quanser UPM-1503 universal power module

Workstations run Windows95 and are served by an ECE-operated Linux server. Application software includes:

- Matlab, Simulink, Labview, DaDiSP

Additional laboratory equipment includes:

- HP LaserJet 5M network printer
- six assorted Quanser Consulting “plants” designed for feedback control education

The Control Systems Laboratory offers students the opportunity to use modern engineering tools in the following course:

- EE-432 *Feedback Control Systems* –Students use Matlab and Simulink to simulate systems and design feedback controllers. Lead and lag controllers are implemented for various plants using the operational amplifier patch panel, and LQR controllers for Quanser plants such as the inverted pendulum and levitated ball are implemented digitally on the computer workstation itself.

- EE-530 *Digital Control Systems* – Matlab and Simulink are used to design and simulate digital control algorithms, which are then implemented on the computer workstation to control a physical plant. Actual responses are measured and compared with simulation results. A typical project is a speed control for the DC servomotor.

Automotive Electronic Systems Laboratory:

This laboratory includes 10 student stations, each normally accommodating two or three students. Each station includes:

- Dell Optiplex GX110 Pentium 4 computer workstation; 733 MHz, 256 MB memory, 14 GB disk, 17-inch LCD monitor, National Instruments oscilloscope, function generator, and multimeter PCI cards
- ETAS ES1000 automotive embedded control development system (on six stations)
- TENMA 72-6153 DC power supply (on six stations)
- Analog Devices SHARC EZ-KIT LITE digital signal processing development board

Workstations run Windows XP Professional. Application software includes:

- National Instruments NI-SCOPE, NI-FGEN, NI-DMM software for NI PCI cards
- ETAS ASCET-SD automotive embedded control software development system and INCA integrated calibration and application tools
- EZNEC antenna analysis software and WinSMITH Smith chart software
- Multisim 2001 circuit simulator, Matlab, Simulink, Labview

Additional laboratory equipment includes:

- ETAS Labcar hardware-in-the-loop vehicle simulator
- Two HP LaserJet network printers

The Automotive Electronic Systems Laboratory offers students the opportunity to use modern engineering tools in the following courses:

- EE-580 *Automotive Electronic Systems* – ASCET-SD is used to simulate automotive control algorithms for multi-sensor, multi-actuator systems and implement them on the ES 1000 automotive embedded control development system. One featured project is an electronic throttle control. Other projects include seat control and cooling system simulation.

- EE-330 *Digital Signal Processing* – Several laboratory experiments and projects are carried out, including the design of digital filters using Matlab and their implementation on the SHARC DSP development board, and implementation of an FFT-based frequency analyzer on the SHARC DSP board.

- EE-430 *Communication Systems* – Several experiments use Matlab and Simulink to explore modulation techniques and communication circuits such as PLLs.

- EE-584 *Wireless Communications for Automotive Applications* – Several laboratory experiments and projects are carried out, including the design of an impedance matching circuit for an antenna using Win SMITH, the design of an antenna using EZNEC, and the simulation of multipath fading communication systems using Matlab and Simulink.

- MFGG-135 *Interdisciplinary Design and Manufacturing* – Multisim 2001 is used to simulate the operation of the PWM driver circuit for the leg actuator of a "walking bug" robot.

Electrical Machines Laboratory:

This laboratory includes 6 student stations, each normally accommodating two students. Each station includes:

- Various Lab-Volt electrical machines, including squirrel cage induction motor, synchronous machine, electro-dynamometer, capacitor-start motor, direct-current machine, wound rotor induction machine and universal motor
- Various Lab-Volt modules, including variable capacitance, resistance and inductance, transformer, ammeter, voltmeter, wattmeter, 3-phse rheostat, SCR speed control, and power supply
- Tektronix 2235 100-MHz oscilloscope
- HP 2048 oscillator
- Harrison Laboratories Model 6226A power supply

The Electrical machines Laboratory offers students the opportunity to use modern engineering tools in the following course:

- EE-342 *Electrical Machines* – Laboratory projects include measurements of motor speed-torque characteristics and machine efficiency and experimental validation of theoretical models and predicted performance of various machines.

High Voltage Laboratory:

This laboratory includes one student station, normally accommodating up to about six students at one time. The station includes:

- Two-state Cockroft-Walton DC voltage generator; 250 kV, 10 mA
- Two-state Marx generator; 250 kV, 200 J
- Tektronix DSA 601 digitizing signal analyzer; 1 GHz bandwidth
- Tektronix 350 MHz Oscilloscope
- Partial Discharge Detector

The High Voltage Laboratory offers students the opportunity to use modern engineering tools in the following course:

- EE-*346 High-Voltage Generation & Measurement Techniques* – About seven laboratory experiments are carried out using the equipment, including performing signal analysis of an impulse voltage waveform using the digitizing signal analyzer and using computational tools such a Matlab and.or MathCad to design a Marx generator for construction in the laboratory.

Microcomputer Laboratory:

This laboratory includes 14 student stations, each normally accommodating two students. Each station includes:

- Dell Optiplex XM 5100 Pentium II computer workstation; 133 MHz, 64 MB memory, 1 GB disk, 15-inch monitor
- Motorola 68HC11EVK development board for the M68HC11 8-bit embedded processor, with an add-on prototyping board for interfacing
- CADET Masterlab prototyping kit with built-in power supply, switch inputs, LED outputs, simple function generator, etc.

Workstations run Windows NT4 Workstation and are served by the ECE Windows NT4 Server Cluster. The ECE Windows NT4 Server Cluster consists of:

- *ECE Windows NT4 Server Cluster* – Two 600-MHz Dell PowerEdge Pentium servers, each with 192 MB memory and 9 GB disk and running Windows NT server, serve accounts, home directories, and applications to the Microcomputer Laboratory and the Microcomputer Development Laboratory. They are powered by an uninterruptible power supply and configured using Vinca Co-Standby Server software as a cluster with automated failover capability. The cluster is owned and maintained by the ECE Department.

Application software available on Microcomputer Laboratory workstations includes:

- 2500AD assembler for Motorola 68HC11

Additional laboratory equipment includes:

- Two HP LaserJet 4000N network printers

The Microcomputer Laboratory offers students the opportunity to use modern engineering tools in the following courses:

- CE-210 *Digital Systems I* – The CADET Masterlab prototyping kit is used to implement and debug discrete-IC SSI and MSI digital circuits in about nine laboratory projects.

- CE-320 *Microcomputers I* – The 2500AD assembler is used to develop programs that are down-loaded to and run on the Motorola 68HC11EVK development board in about nine laboratory projects. Several projects involve interfacing to switches and LEDs on the add-on prototyping board.

Microcomputer Development Laboratory:

This laboratory includes 14 student stations, each normally accommodating two students. Each station includes:

- Dell Optiplex GX1 Pentium III computer workstation; 600 MHz, 128 MB memory, 9 GB disk, 20-inch monitor
- Motorola 68332EVK evaluation kit for the MC68332 32-bit embedded processor
- Motorola M68HC11EVGM development board for the M68HC11 8-bit embedded processor with prototyping area for interfacing

Workstations run Windows NT4 Workstation and are served by the ECE Windows NT4 Server cluster. Application software includes:

- INTROL assemblers and C compilers for Motorola embedded processors, OrCAD schematic capture, ABEL HDL compiler, PSpice circuit simulator, Matlab, and Simulink

Additional laboratory equipment includes:

- One Data I/O Chipmaster 6000 device programmer that supports microprocessors, PROMs, and SPLDs up to 40 pins
- Two HP LaserJet 8000N network printers

The Microcomputer Development Laboratory offers students the opportunity to use modern engineering tools in the following courses:

- CE-310 *Digital Systems II* – OrCAD schematic capture software is used to draw schematics for digital circuits containing up to 10 MSI components. ABEL HDL compiler and Chipmaster device programmer are used to program GAL-type SPLDs. About nine course laboratory projects (all of them) use some combination of these tools.

- CE-420 *Microcomputers II* – INTROL 683xx-family assembler is used to develop programs that are downloaded and run on the Motorola 68332EVK evaluation kit. The kit's monitor program is used for debugging. About nine course laboratory projects (all of them) use these tools.

- CE-426 *Real-Time Embedded Computers* – INTROL 68HC11 assembler and C compiler are used to do preliminary laboratory projects and then to develop and debug a basic real-time operating system that runs on the M68HC11EVM development board.

- EE-230 *Signals and Systems* – Matlab and Simulink are used to compute time-domain responses of linear time-invariant systems using convolution, and frequency responses of linear time-invariant systems.

- EE-320 *Electronics I* – Pspice is used to model operational amplifier, diode and BJT and MOSFET circuits. In particular, Pspice is used to verify the small-signal performance of BJT amplifiers.

- EE 420 *Electronics II* - Pspice is used to assist in the design of transistor amplifiers.

Logic Systems for Manufacturing Laboratory:

This laboratory includes student stations, each normally accommodating two students. Each station includes:

- Allen-Bardley PLCII programmable controller, four 120-VAC input and output modules with a total of 16 switches and 16 lights, and an Allen-Bradley programming terminal
- 13 relays and 9 indicator lights, all 24-VDC, a 24-VDC power supply, 9DPDT switches
- Feedback, Inc. miniature assembly and conveyor system workcell
- CADET Masterlab prototyping kit with built-in power supply, switch inputs, LED outputs, simple function generator, etc.

The Logic Systems for Manufacturing Laboratory offers students the opportunity to use modern engineering tools in the following course:

- CE-316 *Logic Systems for Manufacturing* – Students design and construct safe industrial control systems using digital logic components, relays and programmable controllers.

Senior CE Design Project Laboratory:

This laboratory includes 4 student stations, each normally accommodating two to four students. Each station includes:

- Dell Optiplex GX1 Pentium III computer workstation; 600 MHz, 128 MB memory, 9 GB disk, 20-inch monitor
- Microchip MPLAB ICE2000 In-Circuit Emulator for mid-range PIC processors

Workstations run Windows NT4 Workstation. Application software includes:

- Microchip MPLAB integrated development environment for mid-range PIC processors
- EAGLE schematic capture and PCB layout package
- Quadravox QV400S1 development software for Winbond Chipcorder devices

Additional laboratory equipment includes:

- Quadravox QV400D development board for Winbond Chipcorder devices

The Senior CE Design Project Laboratory offers students the opportunity to use modern engineering tools in the following course:

- CE-*490 Senior CE Design Project* – Usage varies from term to term, but one recurrent project requires students to use EAGLE to design a custom PIC-based hardware platform for a handheld video game system, and MPLAB and ICE2000 to develop the software.

SPARC Workstation Laboratories:

These three laboratories, located in rooms 3-507AB, 3-502AB, and 3-506AB, are maintained by the University's Information Technology group for the use of several academic departments. Each laboratory includes a number of Sun Microsystems SPARC-based workstations, each normally accommodating one or two students for lab use. Exact workstation configurations vary by room:

- *3-507AB* – Sun SPARC Ultra60; 1 GB memory, 9GB disk, 21-inch monitor
- *3-502AB* – Sun Ultra SPARC; 512 MB memory, 18 GB disk, 21-inch monitor
- *3-506AB* – Sun SPARCstation 4; 64 MB memory, 4 GB disk, 21-inch monitor

Workstations run Sun's Solaris (UNIX) operating system and are served by the University's main file/application server system. Application software includes:

- Mentor Graphics Design Architect with QuickHDL VHDL compiler/simulator, SPIM MIPS simulator, Sun Java Development Kit, GNU C compiler, a host of standard UNIX applications and utilities

Additional laboratory equipment in each room includes:

- One HP LaserJet 5SiMX (or similar) network printer

The SPARC Workstation Laboratories offer students the opportunity to use modern engineering tools in the following courses:

- CE-422 Computer Architecture and Organization – The SPIM MIPS simulator is used in tow laboratory projects to familiarize students with MIPS assembly and machine languages. The QuickHDL VHDL compiler/simulator is used in five laboratory projects to build up simulations of single-cycle and multi-cycle implementations of the MIPS architecture.

- EE-428 *VLSI Design* – Mentor Graphics Design Architect is used to design MOSFET-based integrated circuits.

- CS-101/CS-102 *Computing and Algorithms I/II* – The Sun Java Development Kit is used to teach algorithmic problem solving, including a number of software development projects of increasing size and complexity throughout the two-term sequence.

7. Institutional Support and Financial Resources

The electrical engineering program and the computer engineering program share several common resources in the Department of Electrical and Computer Engineering. These two programs do not have separate budgets. For these reasons, this section discusses the institutional support and financial resources available to the department as a whole.

Kettering University supports the needs of the electrical engineering program and the Department of Electrical and Computer Engineering by providing an appropriate number of budgeted faculty positions, competitive faculty salaries to attract and retain faculty, and an adequate budget for operations and for faculty travel. The university's commitment to the department and constructive leadership was demonstrated recently when it increased the number of faculty positions in the department from 17 to 21 over a two year period from 2000 to 2002. While these four new positions were designated for the Computer Engineering program, the impact of increasing the size of the department faculty by about 23% in two years cannot be overstated. Faculty from both programs share some of the responsibility for lower level courses, so this represents a significant increase in the number of resources available to both programs in the department. The university recognized the need for additional faculty generated by the rapid increase in the enrollment of the young computer engineering program and committed significant resources to address this need

<u>Attracting and retaining faculty</u>:

The department currently has two open positions, which it expects to fill by the end of the current academic year. Prior to the 2002—2003 academic year, the department had no resignations of tenured or tenure-track faculty for about eight years. One of the positions is being vacated by the resignation of Professor Cindy Finelli, effective at the end of the 2002-2003 academic year. Professor Finelli is leaving to take a non-faculty, administrative position at the University of Michigan. Her move represents a career change and we do not believe it reflects on the program's ability to retain faculty. The department is conducting a nationwide search to replace her, and we anticipate filling the position this year. The second position is being vacated by Visiting Professor Michael Elta, whose visiting appointment ends at the end of this academic year. Again, his leaving has bearing on the department's ability to retain faculty. Professor Elta's position remains open and budgeted. The department plans on replacing Professor Elta with a tenure-track faculty member, and is conducting a national search to fill this position this year as well.

<u>Professional development</u>:

Professional development for faculty is funded in several ways. First, newly hired faculty at the assistant and associate professor level are provided with a startup professional development account. The amount placed into the account each year is equal to 2/9 of the faculty member's annual salary. Assistant professors receive the contribution for a period of two years from the time of hire and associate professors receive it for three years. Faculty members may use this money for conference travel, workshops, equipment, and other professional development needs. For those who don't have their own professional development accounts, the university provides a travel budget to the department that is expected to be $15,450 (see Table I—5) for the 2003—2004 academic year. As an additional source of professional development funds, the department is fortunate to have two benefactors who understood the need for faculty development and established a fund in honor of their son Richard S. Terrell. This fund was created specifically for the purpose of faculty development. The Terrell fund provides about $5,000 annually to the department for faculty development, and is used to send faculty to workshops. The revenue from this fund is not included in the university's budget and it does not appear in Table I-5. As another source of funds for faculty development and travel, the department may use overhead received from faculty consulting contracts and short courses. This money is placed into an account under control of the department and the current balance appears in Table 7.1. During the 2002-2003 academic year, the department honored every request for travel to a conference or workshop. In addition to financial support and travel money, the department has sufficient faculty to provide a small number of faculty with release time. For example, Professor Finelli's load was reduced by 2/3 so she could serve as director of the university's recently established Center for Excellence in Teaching and Learning.

Financial resources for operations and equipment:

As shown in Table I-5, the department anticipates an operational budget of $81,000 in the 2003—2004 academic year. This budget is used for casual part-time help, consumable supplies, maintenance, rental, repair, and service contracts. The amount budgeted each year in the category is based largely on the budget from the prior year. The university does not provide a line item for major equipment purchases in the department budgets. Instead, equipment purchases are handled somewhat differently. The university provides a budget for equipment purchases to the Provost, who funds capital equipment purchases based on competitive proposals from the academic departments. With this process, budgets for equipment purchases are not carried over from past years, and departments must justify the need for the funds when they are needed. Additionally, the Department of Electrical Engineering has its own capital available for equipment purchases that does not appear in the operating budget provided by the university to the department. This capital resource comes from two sources: corporate and alumni donations and revenue from continuing education short courses and consulting contracts with local industry. The revenue from consulting and short courses is considered to be "Institutional funds in Table I-5 and is typically used to upgrade faculty-related resources, such as faculty computers and some lab equipment. Donations from alumni and corporations were given specifically for equipment in ECE student labs, and are used for that purpose. These funds are placed into accounts that are controlled by the department. Current balances (as of April 14, 2003) in these accounts are shown in Table 7.1.

Table 7.1 Funds available to ECE department

Source	Balance
Overhead from consulting and short courses	$414,959.12
Donations from alumni and corporations	$277,315.19

Recent and planned laboratory upgrades:

In the past year, Agilent donated $182,000 worth of equipment to the department for use in the Electronics lab. This equipment came at no cost to the department. In the past year, the department purchased six work cells for the Logic Systems for Manufacturing laboratory for approximately $30,000. General Motors Corporation donated money for these work cells. The department is currently upgrading the Feedback Control lab with new computers, new data acquisition boards, and target computers to be used for implementation of digital controllers. The cost of this project, which will be completed by the end of the 2002-2003 academic year, is about $18,000.

The next two planned projects are an upgrade of the Digital Systems lab, estimated at $80,000 and an upgrade of the Microcomputers lab, estimated at $50,000. Both of these upgrades are planned for the 2003-2004 academic year. These two labs serve both the Electrical Engineering and the Computer Engineering programs. These two projects can be funded from the currently available funds shown in Table 7.1. Future lab upgrades will be performed as needed as determined by the faculty. The funds shown in Table 7.1 are available to the department faculty. Department faculty members are continually encouraged to submit proposals for the use of these funds to the department head. The department head solicits feedback from the ECE Laboratory Committee before committing sizeable resources. These past and planned lab upgrades have been summarized in Table 7.2.

Table 7.2 Past and planned lab upgrades

Year	Laboratory	Description	Amount
2001-2002	Logic Systems for Manufacturing Lab	Six workcells	$30,000
2001-2002	Electronics Lab	Six Agilent 4395A Network Analyzers	$180,000
2002-2003	Automotive Electronics Lab	Projection system and 8 flat-panel displays	$12,000
2002-2003 (in progress)	Controls Lab	Six new computers, data acquisition boards, and target computers	$18,000
2003-2004	Digital Systems Lab	20 computers, programmable logic development systems, and lab benches	$80,000
2003-2004	Microcomputers Lab	14 computers and evaluation boards, 2 file servers	$50,000

<u>Support personnel and services:</u>

The Department of Electrical and Computer Engineering has a staff of three full-time support personnel: two secretaries, and one technician. The secretaries help the faculty with a variety of tasks such as making copies, typing notes, and making purchases. They also maintain department copies of records, which are used to help advise students and help monitor progress of students through their coursework and thesis project. The technician is responsible for maintaining the lab facilities, for maintaining lab supplies, and for helping faculty set up lab equipment. He makes small repairs himself, but the university provides an electronics repair shop which is used when it's more appropriate. The university has an information technology staff with about 15 employees who help the department maintain its computer systems.

8. Program Criteria

In accordance with the program criteria set by Institute of Electrical and Electronics Engineers (IEEE) and the Program Outcomes, the structure of the Electrical Engineering curriculum is developed such that both breadth and depth are provided across a range of electrical engineering topics. This is achieved by offering required basic courses and a wide variety of advanced courses in the area of electrical engineering as presented in Table 8.1. As can be seen from Table 8.1, in addition to five basic electrical engineering courses, students must take at least six courses as Electrical Engineering Electives in order to gain the breadth in this discipline. Some of the areas of electrical engineering covered in the curriculum are, communications, controls, electronics, electric machines, electromagnetic fields, high-voltage generation techniques, power Systems and Signal Processing. Moreover, to ensure that a student achieves depth, of the six electrical engineering elective courses at least two of them are required to be EE-4xx or EE-5xx level courses, where a EE-3xx course is a prerequisite to a EE-4xx, and a EE-4xx course is a prerequisite to a EE-5xx course.

There are also program specific requirements set by the IEEE for an electrical engineering program. Some of the Program Outcomes *[Program Outcome (a), Program Outcome (c) and Program Outcome (l)]* of the Electrical Engineering Program are similar to these program specific requirements as presented in Section 3.1 of this self-study. To achieve the program specific requirements cited in the document entitled, "Criteria for Accrediting Engineering Programs" by ABET-EAC, students not only take courses in the areas of differential and integral calculus, matrix algebra, differential equations, probability and statistics, basic sciences, computer science and engineering sciences, but also apply the ability and knowledge gained in these courses in analyzing and designing a certain electrical and/or electronic device and systems containing hardware and software components in advanced courses (see Tables 4.1 and 4.2). Students are required to take two courses, namely, Digital Systems I and Microcomputers I from the Computer Engineering Program, and a course in Computing and Algorithms from the Computer Science Program in order to give sufficient depth in hardware and software areas. Students are introduced to hardware and software jointly in Microcomputers I. Furthermore, students may select another computer engineering course if they prefer to do so. The program specific requirements are met in Program Outcome *(a)*, Program Outcome *(c)*, whereas Program Outcome *(l)* needs improvements as described in Tables 3.3, 3.5 and 3.14.

APPENDIX I – Additional Program Information

Tabular Data for Program

Table I-1. Basic-Level Curriculum
Electrical Engineering

Year; Semester or Quarter	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Sciences	Engineering Topics *Check if Contains <u>Significant</u> Design (✓)*	General Education	Other
FR-I	CHEM-135, Principles of Chemistry	3	( )		
	CHEM-136, Principles of Chemistry Lab	1	( )		
	COMM-101, Written & Oral Communication I		( )	4	
	MATH-101, Calculus I	4	( )		
	MFGG-135, Interdisciplinary Design & Manufacturing		4 (✓)		
			( )		
			( )		
FR-II	CS-101, Computing & Algorithms I		( )		4
	HUMN-201, Introduction to the Humanities		( )	4	
	MATH-102, Calculus II	4	( )		
	PHYS-114, Newtonian Mechanics	3	( )		
	PHYS-115, Newtonian Mechanics Lab	1	( )		
			( )		
			( )		
			( )		
			( )		
			( )		
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Table I-1. Basic-Level Curriculum
Electrical Engineering

Year; Semester or Quarter	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Sciences	Engineering Topics *Check if Contains Significant Design (✓)*	General Education	Other
SO-I	MATH-203, Multivariate Calculus	4	( )		
	MECH-210, Mechanics I		4 ( )		
	PHYS-224, Electricity & Magnetism	3	( )		
	PHYS-225, Electricity & Magnetism Lab	1	( )		
	SSCI-201, Introduction to the Social Science		( )	4	
			( )		
			( )		
SO-II	EE-210, Circuits I		4 ( )		
	CE 210, Digital Systems		4 (✓)		
	ECON-201, Economic Principles		( )	4	
	MATH-204, Differential Equations & Laplace Transforms	4	( )		
			( )		
			( )		
			( )		
			( )		
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Table I-1. Basic-Level Curriculum
Electrical Engineering

Year; Semester or Quarter	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Sciences	Engineering Topics *Check if Contains* *<u>Significant</u>* *Design (✓)*	General Education	Other
	COMM-301, Written & Oral Communication II		( )	4	
JR-I	EE-230, Signals & Systems		4 ( )		
	EE-310, Circuits II		4 ( )		
	MATH-307, Matrix Algebra	4	( )		
			( )		
			( )		
			( )		
	EE-240, Electromagnetic Fields		4 ( )		
	EE-320, Electronics I		4 (✓)		
JR-II	MATH-408, Probability & Statistics	4	( )		
	CE-320, Microcomputers I		4 (✓)		
	Engineering Elective		4 ( )		
	Science Elective	4	( )		
			( )		
			( )		
			( )		
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Table I-1. Basic-Level Curriculum
Electrical Engineering

Year; Semester or Quarter	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Sciences	Engineering Topics *Check if Contains <u>Significant</u> Design* (✓)	General Education	Other
SR-I	Advanced Humanities Elective		( )	4	
	EE Electives[1] (3)		12 (✓)		
			( )		
			( )		
	Advanced Social Science Elective		( )	4	
SR-II	EE/CE Elective		4 ( )		
	EE Elective[1] (2 - at least at 400 level)		8 (✓)		
	Free Elective		( )	4	
			( )		
			( )		
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Table I-1. Basic-Level Curriculum
Electrical Engineering

Year; Semester or Quarter	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Science	Engineering Topics *Check if Contains Significant Design (✓)*	General Education	Other
	Senior EE Design Project		4 (✓)		
SR-III	Senior Seminar		( )	4	
	EE Elective[1] (at least 400 level)		4 (✓)		
	Free Elective		( )	4	
	Thesis		( )		4
			( )		
			( )		
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			( )		
			( )		
			( )		
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		40	72	40	8
OVERALL TOTAL FOR DEGREE					
PERCENT OF TOTAL		75%	45%	75%	5%
Totals must satisfy one set	Minimum semester credit hours	32 hrs	48 hrs		
	Minimum percentage	25%	37.5 %		

1. The EE electives must include at least two EE-400 or EE-500 courses.

Table I-2. Course and Section Size Summary

Department of Electrical and Computer Engineering

Electrical Engineering Courses

Course No.	Title	# of Sections offered in Current Year	Avg. Section Enrollment	Type of Class			
				Lecture	Laboratory	Recitation	Other
EE-210	Circuits I	12	35.33	100	0	0	
EE-211	Circuits I Lab	34	12.56	0	100	0	
EE-230	Signals & Systems	4	37.25	100	0	0	
EE-240	Electromagnetic Fields & Applications	5	29	100	0	0	
EE-310	Circuits II	4	31.25	100	0	0	
EE-320	Electronics I	6	25.5	100	0	0	
EE-321	Electronics I Lab	13	11.77	0	100	0	
EE-330	Digital Signal Processing	2	31	100	0	0	
EE-330	Digital Signal Processing Lab	4	15.5	0	100	0	
EE-342	Electrical Machines	2	24.5	100	0	0	
EE-342	Electrical Machines	5	9.8	0	100	0	
EE-344	Fundamentals of Power Systems	2	25	100	0	0	
EE-344	Fundamentals of Power Systems Lab	3	16.67	0	100	0	
EE-346	High Volt. Generators & Measuring Tech	1	16	100	0	0	
EE-346	High Volt. Gen. Measuring Tech Lab	1	16	0	100	0	
EE-348	Electromagnetic Compatibility	1	19	100	0	0	
EE-420	Electronics II	3	19	100	0	0	
EE-420	Electronics II Lab	4	14.25	0	100	0	
EE-424	Power Electronics & Applications	2	13	100	0	0	
EE-424	Power Electronics & Applications Lab	2	13	0	100	0	

Table I-2. Course and Section Size Summary
Department of Electrical and Computer Engineering

Electrical Engineering Courses

Course No.	Title	# of Sections offered in Current Year	Avg. Section Enrollment	Type of Class			
				Lecture	Laboratory	Recitation	Other
EE-425	Principles of Microelectronics Processing	2	35.5	100	0	0	
EE-428	VLSI Design	3	23	100	0	0	
EE-428	VLSI Design Lab	5	13.8	0	100	0	
EE-430	Communication Systems	2	28.5	100	0	0	
EE-432	Feedback Control Systems	2	28.5	100	0	0	
EE-432	Feedback Control Systems Lab	5	11.4	0	100	0	
EE-490	Senior EE Engineering Design Project	4	20.5	25	0	0	75
EE-490	Senior EE Engineering Design Project Lab	4	20.5	0	0	0	100
EE-530	Digital Control Systems	3	12.67	100	0	0	
EE-530	Digital Control Systems Lab	4	9.5	0	100	0	
EE-580	Automotive Electronic Systems	1	11	100	0	0	
EE-580	Automotive Electronic Systems Lab	1	11	0	100	0	
EE-582	Robot Dynamics and Control	2	30.5	100	0	0	
EE-584	Wireless Comm. for Automotive Applications	2	5	100	0	0	

Table I-2. Course and Section Size Summary
Department of Electrical and Computer Engineering
Computer Engineering Courses

Course No.	Title	# of Sections offered in Current Year	Avg. Section Enrollment	Type of Class			
				Lecture	Laboratory	Recitation	Other
CE-210	Digital Systems I	6	31.67	100	0	0	
CE-210	Digital Systems I Lab	12	15.83	0	100	0	
CE-310	Digital Systems II	2	31	100	0	0	
CE-310	Digital Systems II Lab	4	15.5	0	100	0	
CE-316	Logic Systems for Manufacturing	2	18.5	100	0	0	
CE-316	Logic Systems for Manufacturing Lab	2	18.5	0	100	0	
CE-320	Microcomputers I	6	28.5	100	0	0	
CE-320	Microcomputers I Lab	12	14.25	0	100	0	
CE-420	Microcomputers II	2	14.5	100	0	0	
CE-420	Microcomputers II Lab	2	14.5	0	100	0	
CE-422	Computer Architecture & Organization	2	38	100	0	0	
CE-422	Computer Architecture & Organization Lab	5	15.2	0	100	0	
CE-426	Real-Time Embedded Computers	2	28	100	0	0	
CE-426	Real-Time Embedded Computers Lab	4	14	0	100	0	
CE-436	Data Acquisitions & Databases	2	10.5	100	0	0	
CE-436	Data Acquisitions & Databases Lab	2	10.5	0	100	0	
CE-480	Computer Networks	2	33	100	0	0	
CE-480	Computer Networks Lab	4	16.5	0	100	0	
CE-482	Distributed Embedded Systems	1	11	100	0	0	
CE-482	Distributed Embedded Systems Lab	1	11	0	100	0	
CE-490	Senior CE Design Project	4	15.75	25	0	0	75
CE-490	Senior CE Design Project Lab	3	15	0	0	0	100

Table I-2. Course and Section Size Summary
Department of Science & Mathematics
Chemistry Courses

Course No.	Title	# of Sections offered in Current Year	Avg. Section Enrollment	Type of Class			
				Lecture	Laboratory	Recitation	Other
CHEM-135	Principles of Chemistry	11	41.36	75	0	25	
CHEM-136	Principles of Chemistry Lab	23	18.96	0	100	0	
CHEM-145	Industrial Organic Chemistry	10	29.4	100	0	0	
CHEM-146	Industrial Organic Chemistry Lab	15	19.13	0	100	0	
CHEM-171	Environmental & Safety Policies	1	6	100	0	0	
CHEM-223	Introduction to Polymer Science	5	33.6	100	0	0	
CHEM-227	Industrial Painting Technology	1	24	100	0	0	
CHEM-237	General Chemistry II	2	6.5	100	0	0	
CHEM-238	General Chemistry II Lab	2	6.5	0	100	0	
CHEM-271	Handling Hazardous Material	1	17	100	0	0	
CHEM-345	Organic Chemistry I	2	5	100	0	0	
CHEM-346	Organic Chemistry I Lab	2	4.5	0	100	0	
CHEM-347	Organic Chemistry II	2	5	100	0	0	
CHEM-348	Organic Chemistry II Lab	2	4.5	0	100	0	
CHEM-351	Biochemistry	1	2	100	0	0	
CHEM-352	Biochemistry Lab	1	2	0	100	0	
CHEM-361	Physical Chemistry I	1	2	100	0	0	
CHEM-362	Physical Chemistry I Lab	1	2	0	100	0	
CHEM-363	Physical Chemistry II	1	2	100	0	0	
CHEM-364	Physical Chemistry II Lab	1	2	0	100	0	
CHEM-373	Analytical Chemistry	1	3	100	0	0	
CHEM-374	Analytical Chemistry Lab	1	2	0	100	0	

Table I-2. Course and Section Size Summary

Department of Science & Mathematics

Chemistry Courses

Course No.	Title	# of Sections offered in Current Year	Avg. Section Enrollment	Type of Class			
				Lecture	Laboratory	Recitation	Other
CHEM-437	Advanced Inorganic Chemistry	1	6	100	0	0	
CHEM-438	Advanced Inorganic Chemistry Lab	1	6	0	100	0	
CHEM-471	Environmental Inorganic Chemistry	1	6	100	0	0	
CHEM-472	Environmental Inorganic Chemistry Lab	1	6	0	100	0	
CHEM-475	Environmental Organic Chemistry	1	6	100	0	0	
CHEM-476	Environmental Organic Chemistry Lab	1	6	0	100	0	

Table I-2. Course and Section Size Summary
Department of Science & Mathematics
Computer Science Courses

Course No.	Title	# of Sections offered in Current Year	Avg. Section Enrollment	Type of Class			
				Lecture	Laboratory	Recitation	Other
CS-101	Computing & Algorithms I	7	28	100	0	0	
CS-101	Computing & Algorithms I Lab	15	13.07	0	100	0	
CS-102	Computing & Algorithms II	5	18.40	100	0	0	
CS-102	Computing & Algorithms II Lab	9	10.22	0	100	0	
CS-202	System Programming Concepts	4	18.25	100	0	0	
CS-202	System Programming Concepts Lab	7	10.57	0	100	0	
CS-203	Computing & Algorithms III	3	12.33	100	0	0	
CS-203	Computing & Algorithms III Lab	4	9.25	0	100	0	
CS-211	Discrete Mathematics	4	18.75	100	0	0	
CS-312	Theory of Computation	4	5.75	100	0	0	
CS-415	Cryptography	2	12	100	0	0	
CS-425	Parallel Models & Algorithms	2	7	100	0	0	
CS-425	Parallel Models & Algorithms Lab	2	7	0	100	0	
CS-431	Compiler Design & Const. I	2	10.5	100	0	0	
CS-431	Compiler Design & Const. I Lab	2	10.5	0	100	0	
CS-451	Operating Systems I	4	13.25	100	0	0	
CS-451	Operating Systems I Lab	6	8.83	0	100	0	
CS-455	Computer & Network Security	1	14	100	0	0	
CS-455	Computer & Network Security Lab	1	14	0	100	0	
CS-461	Database Systems	2	10.5	100	0	0	
CS-461	Database Systems Lab	3	7	0	100	0	
CS-471	Software Engineering	1	7	100	0	0	

Table I-2. Course and Section Size Summary

Department of Science & Mathematics

Math Courses

Course No.	Title	# of Sections offered in Current Year	Avg. Section Enrollment	Type of Class			
				Lecture	Laboratory	Recitation	Other
MATH-101	Calculus I	13	22.08	100	0	0	
MATH-101X	Calculus I	4	24.5	80	0	20	
MATH-102	Calculus II	20	29.95	100	0	0	
MATH-203	Multivariate Calculus	20	29	100	0	0	
MATH-204	Diff Equations and Laplace Transforms	19	28.05	0	100	0	
MATH-205	Probability	2	12.5	100	0	0	
MATH-307	Matrix Algebra	10	30.9	100	0	0	
MATH-313	Boundary Value Problems	2	11.5	100	0	0	
MATH-328	Methods of Applied Mathematics	1	5	100	0	0	
MATH-408	Probability & Statistics	13	26.77	100	0	0	
MATH-412	Complex Variables	3	4.67	100	0	0	
MATH-416	Vector Analysis	1	5	100	0	0	
MATH-420	Mathematical Modeling	2	5.5	100	0	0	
MATH-426	Mathematical Statistics I	1	6	100	0	0	

Table I-2. Course and Section Size Summary

Department of Science & Mathematics

Physics Courses

Course No.	Title	# of Sections offered in Current Year	Avg. Section Enrollment	Type of Class			
				Lecture	Laboratory	Recitation	Other
PHYS-114	Newtonian Mechanics	13	44.31	75	0	25	
PHYS-115	Newtonian Mechanics Lab	27	18.52	0	100	0	
PHYS-224	Electricity & Magnetism	14	37.07	75	0	25	
PHYS-225	Electricity & Magnetism Lab	25	18.88	0	100	00	
PHYS-342	Materials Science	2	14	100	0	0	
PHYS-362	Modern Physics	2	11	100	0	0	
PHYS-362	Modern Physics Lab	2	11	0	100	0	
PHYS-372	Optics I	2	15	100	0	0	
PHYS-372	Optics I Lab	4	7.5	0	100	0	
PHYS-382	Acoustics I: Sounds & Sources	2	32	100	0	0	
PHYS-412	Theoretical Mechanics	1	6	100	0	0	
PHYS-452	Thermodynamics & Stats Physics	2	4.5	100	0	0	
PHYS-472	Optics II	1	4	100	0	0	
PHYS-474	Optoelectronics	1	7	100	0	0	
PHYS-476	Fiber Optics	1	4	100	0	0	
PHYS-482	Acoustics II	1	6	100	0	0	
PHYS-484	Acoustical Measurements	1	7	100	0	0	
PHYS-484	Acoustical Measurements Lab	1	7	0	100	0	

Table I-2. Course and Section Size Summary
Department of Liberal Studies
Communication, Humanities, and Social Science Courses

Course No.	Title	# of Sections offered in Current Year	Avg. Section Enrollment	Type of Class			
				Lecture	Laboratory	Recitation	Other
COMM-101	Written & Oral Communication I	21	20.90	100	0	0	
COMM-301	Written & Oral Communication II	31	17.9	100	0	0	
ECON-201	Economic Principles	14	35.29	100	0	0	
ECON-342	Managerial Economics	2	34	100	0	0	
ECON-344	Economic Growth & Fluctuations	2	31.5	100	0	0	
ECON-346	Introduction to Econometrics	2	17	100	0	0	
ECON-348	History of Economic Thought	3	28.67	100	0	0	
ECON-350	Comparative Economic Systems	5	23.20	100	0	0	
HIST-308	America and the World	1	7	100	0	0	
HIST-316	History of the Atlantic World	1	16	100	0	0	
HIST-318	Africa in the 20th Century	1	9	100	0	0	
HIST-320	Modern Middle East	1	5	100	0	0	
HUMN-201	Introduction to Humanities	24	24.63	100	0	0	
HUMN-302	Ideas of the Modern Age	1	25	100	0	0	
HUMN-376	American Culture & Technology	1	33	100	0	0	
PHIL-373	Philosophy	4	25.5	100	0	0	
PHIL-378	Moral & Ethical Philosophy	1	12	100	0	0	

Table I-2. Course and Section Size Summary

Department of Liberal Studies

Communication, Humanities, and Social Science Courses

Course No.	Title	# of Sections offered in Current Year	Avg. Section Enrollment	Type of Class			
				Lecture	Laboratory	Recitation	Other
LIT-304	American Literature & Philosophy	1	27	100	0	0	
LIT-309	The Literature of Multicultural America	1	33	100	0	0	
LIT-315	Literature of the Fantastic	3	29.67	100	0	0	
LIT-317	Masterpiece of Drama	1	30	100	0	0	
LIT-372	Masterpieces of Literature	5	28.80	100	0	0	
LIT-379	The Plays of Shakespeare	3	32	100	0	0	
LS-489	Senior Seminar: Leadership, Ethics	11	16.18	100	0	0	
SOC-332	Contemporary Social Problems	1	15	100	0	0	
SOC-335	Analysis of Social Dissent	1	3	100	0	0	
SOC-336	Sociology of the Family	5	15.8	100	0	0	
SOC-337	Religion in Society	3	14.67	100	0	0	
SOC-338	Gender and Society	1	23	100	0	0	
SSCI-201	Introduction to Social Science	15	23.67	100	0	0	
SSCI-303	Globalization & Human Development	1	10	100	0	0	
SSCI-303	Political Economics of Human Rights	1	11	100	0	0	

Table I-2. Course and Section Size Summary
Department of Mechanical Engineering
Mechanical Engineering Courses

Course No.	Title	# of Sections offered in Current Year	Avg. Section Enrollment	Type of Class			
				Lecture	Laboratory	Recitation	Other
MECH-210	Mechanics I	15	35.67	100	0	0	

Table I-2. Course and Section Size Summary
Department of Industrial Manufacturing Engineering & Business
Interdisciplinary Course

Course No.	Title	# of Sections offered in Current Year	Avg. 8 Section Enrollment	Type of Class			
				Lecture	Laboratory	Recitation	Other
MFGG-135	Interdisciplinary Design & Mfg	8	58.75	100	0	0	
	Interdisc. Design & Mfg Lab	16	15.06	0	0	0	100
	Interdisciplinary Man Pro Lab	40	11.45	0	100	0	

Table I-3. Faculty Workload Summary
Electrical Engineering Faculty

Faculty Member (Name)	FT or PT (%)	Classes Taught (Course No./Credit Hrs.) Spring B - 2003	Total Activity Distribution		
			Teaching %	Research %	Other %
James Gover	FT	EE 210/3, EE 211-L/1, EE 240/4	40	40	20
Bhag Guru	FT	EE 210/3, EE 342/3, EE 342-L/1, EE 432-L/1	60	20	20
Huseyin Hiziroglu	FT	EE 344/3, EE 344-L/1, EE 424/3, EE 424-L/1	60	25	15
James McLaughlin	FT	EE 320/3, EE 321-L/1, EE 321-L/1, CE 320-L/1	90	0	10
Douglas Melton	FT	EE 330/3, EE 330/1, EE 584/4	75	0	25
Karen Palmer	FT	EE 230/4, EE 310/4	70	5	25
Laura Rust	FT	EE 210/3, EE 211-L/1, EE 211-L/1, MFGG-135/1, MFGG-135/1	80	5	15
Mark Thompson	FT	EE 420/3, EE 420-L/1, MFGG-135/1, MFGG-135/1	75	5	20
Mohammad Torfeh	FT	EE 530/3, EE 530-L/1	65	0	35
Ravi Warrier	FT	EE 211-L/1, EE 211-L/1, EE 211-L/1, EE 321-L/1	85	5	10

Table I-3. Faculty Workload Summary
Computer Engineering Faculty

Faculty Member (Name)	FT or PT (%)	Classes Taught (Course No./Credit Hrs.) Spring B - 2003	Total Activity Distribution		
			Teaching %	Research %	Other %
David Foster	67%	CE 210-L/1, CE 210-L/1, CE 210-L/1, CE 210-L/1	100	0	0
James McDonald	FT	CE 422/3, CE 422-L/1, CE 422-L/1	50	0	50
Gene Miller	FT	CE 210/3, CE 436/3, CE 436-L/1	60	0	40
Juan Pimentel	FT	CE 482/3, CE 482-L/1, CE 490/2, CE 490-L/2	50	35	15
Weihua Sheng	FT	CE 210/3, CE 320/3, CE 320-L/1	50	40	10
Girma Tewolde	FT	CE 310/3, CE 310-L/1, CE 310-L/1	80	10	10

Table I-3. Faculty Workload Summary
Electrical Engineering Faculty

Faculty Member (Name)	FT or PT (%)	Classes Taught (Course No./Credit Hrs.) Summer A - 2002	Total Activity Distribution		
			Teaching %	Research %	Other %
Michael Elta	FT	EE 210-L/1, EE 240/4, EE 320-L/1	100	0	0
James Gover	FT	EE 210/3, EE 210-L/1, EE 210-L/1	75	25	0
Bhag Guru	FT	EE 210/3, EE 210-L/1, EE 320/3, EE 320-L/1, EE 320-L/1	60	20	20
Kenneth Kaiser	FT	EE 210-L/1, EE 348/4, EE 490/2, EE 490-L/2	40	50	10
David Leffen	FT	EE 210-L/1, EE 428/3, EE 428-L/1, EE 428-L/1, EE 428-L/1	90	0	10
Douglas Melton	FT	EE 430/4, EE 490/2, EE 490-L/2	75	0	25
Karen Palmer	FT	EE 310/4, EE 432-L/1, EE 530/3, EE530-L/1	75	0	25
Juan Pimentel	FT	EE 210/3	60	10	30
Laura Rust	FT	CE 210/3, MFGG-135/1, MFGG-135/1, MFGG-135/1	80	10	10
Mohammad Torfeh	FT	EE 432/3, EE 432-L/1, EE 432-L/1	65	0	35

Table I-3. Faculty Workload Summary
Computer Engineering Faculty

Faculty Member (Name)	FT or PT (%)	Classes Taught (Course No./Credit Hrs.) Summer A - 2002	Total Activity Distribution		
			Teaching %	Research %	Other %
David Foster	67%	CE 210-L/1, CE 210-L/1, CE 320-L/1, CE 320-L/1	100	0	0
James McDonald	FT	CE 320/3, CE 490/2, CE 490/2	65	0	35
Gene Miller	FT	CE 316/3, CE 316-L/1, CE 426/3, CE 426-L/1	70	0	30
Juan Pimentel	FT	CE 480/3, CE 480-L/1, CE 480-L/1	50	35	15
Girma Tewolde	FT	CE 320/3, CE 320-L/1, CE 320-L/1,CE 420/3, CE 420-L/1	80	10	10

Table I-3. Faculty Workload Summary

Electrical Engineering Faculty

Faculty Member (Name)	FT or PT (%)	Classes Taught (Course No./Credit Hrs.) Fall B - 2002	Total Activity Distribution		
			Teaching %	Research %	Other %
Michael Elta	FT	EE 210-L/1, MFGG-135/1, MFGG-135/1	100	0	0
Cynthia Finelli	33%	EE 230/4, EE 230/4	25	10	65
James Gover	FT	EE 210/3, EE 210-L/1, EE 210-L/1, EE 240/4	75	25	0
Bhag Guru	FT	EE 320/3, EE 320-L/1, EE 320-L/1, EE 420/3, EE 420-L/1	60	20	20
Huseyin Hiziroglu	FT	EE 346/3, EE 346-L/1	45	20	35
Kenneth Kaiser	FT	EE 210/3, EE 310-L/1	40	50	10
David Leffen	FT	EE 320/3, EE 428/3, EE 428-L/1	90	0	10
James McLaughlin	FT	EE 210-L/1, EE 210-L/1, CE 320/3, CE 320/3	90	0	10
Mark Thompson	FT	EE 490/2, EE 490-L/2, MFGG-135/1, MFGG-135/1	75	5	20
Mohammad Torfeh	FT	EE 432/3, EE 432-L/1, EE 432-L/1, EE 482/4	65	0	35
Ravi Warrier	FT	EE 210/3, EE 430/4	60	20	20

Table I-3. Faculty Workload Summary
Computer Engineering Faculty

Faculty Member (Name)	FT or PT (%)	Classes Taught (Course No./Credit Hrs.) Fall B - 2002	Total Activity Distribution[2]		
			Teaching	Research	Other[3]
David Foster	67%	CE 320-L/1, CE 320-L/1, CE 320-/L/1, CE 320-L/1	100	0	0
Gene Miller	FT	CE 316/3, CE 316-L/1, CE 316-L/1, CE 426-3, CE 426-L/1, CE 426-L/1	75	0	25
Juan Pimentel	FT	CE 490/2, CE 490-L/2	60	10	30
Weihua Sheng	FT	CE 480/3, CE 480/3, CE 480-L/1, CE 480-L/1	60	30	10
Girma Tewolde	FT	CE 210/3, CE 210-L/1, CE 210-L/1, CE 420/3, CE 420-L/1	80	10	10

Table I-4. Faculty Analysis
Computer Engineering

Name	Rank	FT or PT	Highest Degree	Institution from which Highest Degree Earned & Year	Years of Experience			State in which Registered	Level of Activity (high, med, low, none)		
					Govt./ Industry Practice	Total Faculty	This Institution		Professional Society (Indicate Society)	Research	Consulting /Summer Work in Industry
G. Castelino	Assoc	FT	PhD	Oakland University 1986	0	17	17		None	Low	Med
D. Foster	Lect	PT	MS	University of Michigan 2003	0	2	2		None	Low	Med
J. McDonald	Assoc	FT	PhD	Rice University 1992	7	12	4		IEEE Low	None	None
G. Miller	Prof	FT	MSEE	Purdue University 1967	2	36	36	MI	SME Low	None	None
J. Pimentel	Prof	FT	PhD	University of Virginia 1980	2	23	23		IEEE (Med) SAE (Med)	Med	Low
G. Tewolde	Lect	FT	MS	University of New South Wales Sydney, Australia 1995	3 mos	5	1.6		None	Low	None
W. Sheng	Assist	FT	PhD	Michigan State University 2002	1	1	1		IEEE (Med) R & A Computer	High	Low
M. Wicks	Assoc	FT	PhD	Purdue University 1992	3	10	11		IEEE Low	Low	Low

Table I-4. Faculty Analysis
Electrical Engineering

Name	Rank	FT or PT	Highest Degree	Institution from which Highest Degree Earned & Year	Years of Experience			State in which Registered	Level of Activity (high, med, low, none)		
					Govt./ Industry Practice	Total Faculty	This Institution		Professional Society (Indicate Society)	Research	Consulting /Summer Work in Industry
M. Elta	Visit. Prof	FT	PhD	University of Michigan 1978	5	25	1.6		None	Low	Med
C. Finelli	Assoc	PT	PhD	University of Michigan 1993	1	11	11		Med	Med	None
J. Gover	Prof	FT	PhD	University of New Mexico 1971	35	5	5		IEEE (High) EMCWA (High)	Med	High
B. Guru	Prof	FT	PhD	Michigan State University 1976	6	20	19		None	Med	Low
H. Hiziroglu	Prof	FT	PhD	Wayne State University 1982	4	22	20		IEEE CEIDP (High)	Med	Low
K. Kaiser	Assoc	FT	PhD	Purdue University 1989	3	14	13		IEEE Low	High	Low
D. Leffen	Prof	FT	PhD	University of Waterloo Canada 1973	8	29	15	Ontario Canada	None	Low	None
J. McLaughlin	Assoc	FT	JD	Cooley Law School 1985	5	39	39	Michigan	None	Low	Med
D. Melton	Assoc	FT	PhD	University of Wisconsin 1993	4	8	8		Med	Low	High
K. Palmer	Assoc	FT	PhD	Massachusetts Institute of Technology 1995	5	8	8		Low	Low	None

Table I-4. Faculty Analysis
Electrical Engineering

Name	Rank	FT or PT	Highest Degree	Institution from which Highest Degree Earned & Year	Years of Experience			State in which Registered	Level of Activity (high, med, low, none)		
					Govt./ Industry Practice	Total Faculty	This Institution		Professional Society (Indicate Society)	Research	Consulting /Summer Work in Industry
L. Rust	Assoc	FT	PhD	New Mexico State University 1994	3	17	8		Low	Low	None
M. Thompson	Prof	FT	PhD	Michigan State University 1980	1	22	14		SAE, ASEE (Med) (Med) EMCWA (Med)	Low	Low
M. Torfeh	Prof	FT	PhD	Wayne State University 1982	4	21	21		None	Low	Med
R. Warrier	Prof	FT	PhD	University of New Mexico 1985	4	18	15		None	Low	None

Table I-5. Support Expenditures

Electrical and Computer Engineering

Fiscal Year	1	2	3	4
	2000-2001	2001-2002	2002-2003	2003-2004
Expenditure Category				
Operations (not including staff)	$69,399	$62,524	$68,500	$81,000
Travel	$17,691	$13,758	$10,000	$15,450
Equipment	$66,406	$62,998	$159,487	$150,000[1]
Institutional Funds	$45,237	$57,478	$123,334	$100,000[1]
Grants and Gifts	$21,169	$5,520	$36,153	$50,000[1]
Graduate Teaching Assistants	$1,000	$4,320	$32,280	$32,280
Part-time Assistance (other than teaching)	$1,732	$2,581	$2,500	$2,100

[1] The amounts shown in column 4 are not budgeted by the University but are expenditure estimates for equipment to be purchased from department capital resources. See Section B.7 for more information.

B. Course Syllabi

CHEM-135
PRINCIPLES OF CHEMISTRY

DEPARTMENT	Science and Math
COORDINATOR	Brent Lewis, Assistant Professor of Chemistry
CATALOG DESCRIPTION	An introduction to fundamental concepts and applications of chemistry, including the Periodic Table and chemical nomenclature, reactions and reaction stoichiometry, atomic structure, chemical bonding and chemical equilibrium. Applied topics include batteries, fuel cells and corrosion, and a description of the chemistry and uses of metals and nonmetals. Includes three hours of lecture per week.
PREREQUISITES	None
CO-REQUISITES	CHEM-136, Principles of Chemistry Laboratory
CLASS/LAB SCHEDULE	Four 60-minute class periods per week (3-0-3)
TEXTBOOK	R. Chang, *Chemistry*, 6th Ed., McGraw-Hill Publishing, 1994
REFERENCE	
CREDITS	Basic Science: 4 credits

RELATIONSHIP TO PROGRAM OUTCOMES

CHEM-135 achieves the following Program Outcomes:

Primary: (a), (d), and (i)

COURSE LEARNING OBJECTIVES

Each student who receives credit for CHEM-135 will have demonstrated the ability to do all of the tasks listed below:

1. Properly identify and/or name periodic groups, molecules and ions, and basic inorganic compounds.
2. Perform calculations involving unit conversions, mass/mole conversions, reaction stoichiometry and reaction yields, concentration units, solutions preparation and classical analytical methods.
3. Identify and write chemical reaction equations for acid-base, oxidation-reduction and precipitation reactions.
4. Describe the general characteristics of acid-base, oxidation-reduction and precipitation reactions, write reaction equations for each, and predict the products of these reactions.
5. Describe the structure of the atom and relate that structure to the concepts of chemical bonding and reactivity, including quantum theory, periodic trends of the elements, ionic/covalent bonding, molecular geometry and bonding models.
6. Describe the physical and chemical properties of metals and nonmetals and their uses.
7. Describe chemical equilibria, write equilibrium constant expressions and predict shifts in chemical equilibrium under the effect of different factors.
8. Describe the principles of electrochemical cells, batteries, fuel cells and corrosion.

TOPICS

1. SI units, scientific notation, significant figures, unit conversion (self-study)
2. Atoms, molecules and ions (3 classes)
3. Stoichiometry (3 classes)
4. Reactions in Aqueous Solutions (4 classes)
5. Chemical Equilibria (2 classes)
6. Applications of electrochemistry (2 classes)
7. Atomic structure (4 classes)
8. Periodic Trends (2 classes)
9. Chemistry of metals and nonmetals (3 classes)
10. Chemical bonding (3 classes)
11. Molecular geometry (1 class)
12. Recitation (10 classes)
13. Exams (3 classes)

This syllabus was prepared by Brent Lewis   Last revised on August 26, 2000

CHEM-136

PRINCIPLES OF CHEMISTRY LAB

DEPARTMENT	Science and Math
COORDINATOR	Brent Lewis, Associate Professor of Chemistry
CATALOG DESCRIPTION	The laboratory introduces and/or illustrates chemical concepts and principles, and teaches the skills of data collection and evaluation. The SI system is emphasized.
PREREQUISITES	None
CO-REQUISITES	CHEM-135, Principles of Chemistry
CLASS/LAB SCHEDULE	One 120-minute laboratory session per week (0-2-1)
TEXTBOOK	In-house manual
REFERENCE	
CREDITS	Basic Science: 1 credit

RELATIONSHIP TO PROGRAM OUTCOMES

CHEM-136 achieves the following Program Outcomes:

Primary: (a), (d), and (i)

COURSE LEARNING OBJECTIVES

Each student who receives credit for CHEM-136 will have demonstrated the ability to do all of the tasks listed below:

1. Demonstrate an understanding of and the application of common safety procedures in a chemical laboratory setting.
2. Demonstrate the proper use of common laboratory glassware and instrumentation.
3. Interpret and apply data collected in the laboratory exercises.
4. Carry out chemical reactions and analytical procedures to achieve specified results.
5. Classify elements on the basis of their properties and chemical reactivity.
6. Utilize modern instrumentation and instrumental methods to quantify and/or identify analytes.
7. Demonstrate evidence of effective teamwork and scientific communication.

TOPICS

1. Safety in the chemistry laboratory and measurements in chemistry (2 classes)
2. Conductivity (2 classes)
3. Qualitative and quantitative analysis (2 classes)
4. Acid-base titrations (2 classes)
5. pH, midterm exam (2 classes)
6. Electrochemistry (2 classes)
7. Periodic trends (2 classes)
8. Emission spectroscopy (2 classes)
9. UV/VIS and atomic absorption spectroscopy (2 classes)
10. Lab practical (2 classes)

This syllabus was prepared by Andrzej Przyjazny and Lihua Wang Last revised on August 10, 2000

COMM-101
WRITTEN & ORAL COMMUNICATION I

DEPARTMENT	Liberal Studies
COORDINATOR	Communication Faculty
CATALOG DESCRIPTION	This course is designed to help students write and speak effectively in academic settings and in their work organizations. Basic principles underlying practical communication techniques are taught, with an emphasis on skills for conveying technical and business information. Students engage in writing and speaking assignments that familiarize them with appropriate formats for those kinds of communication. Student performance is analyzed as a means of promoting individual improvement.
PREREQUISITES	
CO-REQUISITES	
CLASS/LAB SCHEDULE	Four 60-minute sessions per week or two 120-minute sessions per week. (4-0-4)
TEXTBOOK	M. Giffey, *Business Communication: Process & Product*, 3rd ed., Southwestern P. Anderson, *Technical Communication*, 4th ed.
REFERENCE	F. Crews, S. Schor, and M. Hennessy, *The Borzoi Handbook for Writers*, 3rd ed., McGraw-Hill
CREDITS	General Education: 4 credits

RELATIONSHIP TO PROGRAM OUTCOMES

COMM-101 achieves the following Program Outcomes:

Primary: (d) and (g)

COURSE LEARNING OBJECTIVES

Each student who receives credit for COMM-101will have demonstrated the ability to do all of the tasks listed below:

1. Use reasoning procedures of critical thinking
2. Analyze social-stylistic elements of workplace communication
3. Perform audience analysis
4. Prepare workplace documents
5. Deliver effective presentations
6. Use available resources for employing correct English mechanics

TOPICS

1. Foundations of communication (rhetoric, audience, means of persuasion)
2. Writing as a process (planning, writing, revising)
3. Business and professional documents (memos, letters, proposals)
4. Report writing (persuasive)
5. Research techniques (library and electronic research, APA documentation)
6. Presentation techniques (research, planning, graphics, visuals, performance)

This syllabus was prepared by Barbara Ward Last revised on June 12, 2000

COMM-301
WRITTEN & ORAL COMMUNICATION II

DEPARTMENT	Liberal Studies
COORDINATOR	Communication Faculty
CATALOG DESCRIPTION	This course prepares students to launch their thesis projects and to perform other advanced writing and speaking tasks. Thus, students will employ the concepts and skills gained in the foundational course Written & Oral Communication I (COMM-101). Emphasis is placed on helping students to communicate effectively in regard to the technologies and business purposes of their own workplace and professions. Students' development of the required skills is demonstrated in writing assignments and oral presentations. Credit must be received for the course before a student's Senior Thesis Assignment Proposal will be processed for its approval.
PREREQUISITES	
CO-REQUISITES	
CLASS/LAB SCHEDULE	Four 60-minute sessions per week or two 120-minutes sessions per week. (4-0-4)
TEXTBOOK	P. Anderson, *Technical Communication*, 4th ed., Harcourt Brace, or D. Beer and D. McMurray, *A Guide to Writing as an Engineer*, John Wiley & Sons, or M. Lay, et al, *Technical Communication*, 4th ed., Irwin
REFERENCE	Publication Manual of the American Psychological Association, 4th ed., American Psychological Association Operating Handbook for the Senior Thesis Project, latest revised edition, Kettering University F. Crews, S. Schor, and M. Hennessy, *The Borzoi Handbook for Writers*, 3rd ed., McGraw-Hill
CREDITS	General Education: 4 credits

RELATIONSHIP TO PROGRAM OUTCOMES

COMM-301 achieves the following Program Outcomes:

Primary: (d) and (g)

Course Learning Objectives

Each student who receives credit for COMM-301 will have demonstrated the ability to do all of the tasks listed below:

1. Prepare a thesis proposal for a practice topic or a tentative actual topic
2. Plan the content of a thesis document
3. Apply the principles of technical writing
4. Follow formatting and documentation requirements
5. Choose conversation strategies for adapting the thesis content and style to additional written and oral formats that may be required for individual students' own workplace or profession.

Topics

1. Proposals (workplace and research-based)
2. Professional report writing on technical topics (rhetorical perspective)
3. Planning a senior thesis document (communication strategies)
4. Role of criteria in the structure of analysis (critical reading & analytical writing)
5. Graphics for illustrating text (presentation and interpretation)
6. APA documentation style and other thesis formatting requirements (using and documenting secondary sources)
7. Advanced presentation techniques (principles and practice)

This syllabus was prepared by Barbara Ward　　　　Last revised on June 12, 2000

CE-210
DIGITAL SYSTEMS I

(Required course for EE)

DEPARTMENT	Electrical & Computer Engineering
COORDINATOR	Gene H. Miller, Professor of Computer Engineering
CATALOG DESCRIPTION	Formal design techniques for combinational and sequential logic circuits are studied. Topics include number systems and codes, combinational logic networks, registers, synchronous sequential networks, control units, instruction-controlled systems, and stored program processors.
PREREQUISITES	CS-101, Computing and Algorithms I
CO-REQUISITES	
CLASS/LAB SCHEDULE	Three 60-minute class periods and one 120-minute laboratory session per week. (3-2-4)
TEXTBOOK	Course Notes
REFERENCE	
CREDITS	Engineering Science: 2 credits; Engineering Design: 2 credits.

RELATIONSHIP TO PROGRAM OUTCOMES

CE-210 achieves the following Program Outcomes:

Primary: (a), (b), (c), (e), (k), and (l); *Secondary*: (d) and (g)

COURSE LEARNING OBJECTIVES

Each student who receives credit for CE-210 will have demonstrated the ability to do all of the tasks listed below:

1. Represent numbers I various number systems; add and subtract binary two's complement numbers; write a gray code.
2. Define a bit, and calculate how many quantities can be represented by different numbers of bits.
3. Create a truth table, logic equation, or word description for a logic function, given any one of these three representations.
4. Use electronic logic devices including gates and inverters to design circuits from a specification of both the available hardware and a logic equation, and be able to properly document the resulting circuit diagram using mixed-logic notation.
5. Write a logic equation that describes the operation of a given logic circuit labeled with mixed-logic notation.
6. Write an equivalent canonical sum-of-products (SOP) and a canonical product-of-sums (POS) equation using either variables or the *m*-notion when given logic function specified by a truth table, a logic equation, or a word description.
7. Use the Karnaugh map method to obtain a minimal SOP and a minimal POS expression for a truth table that may contain "don't cares".
8. Describe or design a half-adder and a full-adder and design a multi-bit adder by combining single-bit adders.
9. Understand decoders and multiplexors, and be able to synthesize a combinational logic network using a decoder as minterm/maxterm generator.
10. Design a single-bit AU and design a multi-bit ALU by combining single-bit ALUs.
11. Make the transition tables for SR, D, and JK flip flops.
12. Create a state transition diagram for a synchronous sequential network given either a word description or a circuit diagram.
13. Design a circuit for a synchronous sequential network when given a state transition diagram and specified components.

TOPICS

1. Number systems including binary, octal, hexadecimal, BCD, and two's complement numbers; coding including gray code and ASCII
2. Binary signals, variables, logic functions, logic gates, and Boolean algebra
3. Logic equations – canonical SOP and POS forms and simplification using Karnaugh maps
4. Half-adders and full-adders; designing large multi-bit circuits from single-bit building blocks
5. Decoders and multiplexor; generating minterms and maxterms with a decoder; buses and transfer gates, the building blocks of an ALU
6. Memory devices – SR flip flop, transition tables, timing diagrams; clocked flip flops – latch, master-slave SR, dynamic indicator, JK and D flip flops, direct clear
7. Synchronous sequential networks (SSN) – Mealy and Moore machines, reason for clock; state transition diagrams; design of SSN with D, JK, or SR flip flops; timing diagram
8. Registers-design parallel registers and shift registers with flip flops; ripple counters; design a controlled shift register using single-bit building blocks
9. Memories – address and data buses; ROMs – design a ROM with a decoder and OR gates, fusible link PROM, making combinational networks with a PROM
10. Design of digital systems – control unit (SSN) with other hardware; control shift register using a PROM in design of control unit
11. Design of arithmetic processor- design control unit for ALU and registers
12. Design of instruction-controlled arithmetic processor; introductory stored program processor and computer architecture

This syllabus was prepared by Gene Miller — Last revised on July 14, 2000

CE-320
MICROCOMPUTERS I

(Required course for EE)

DEPARTMENT Electrical & Computer Engineering

COORDINATOR Mark Wicks, Associate Professor of Computer Engineering

CATALOG DESCRIPTION Principles of microcomputer hardware and software are presented. Topics include instruction sets and addressing modes; structured assembly language programming; top/down design; introductory machine architecture and its relationship to programming; introduction to hardware found in typical microcontrollers; microcomputer interfacing using standard integrated circuits.

PREREQUISITES CE-210, Digital Systems I
CS-101, Computing Algorithms I

CO-REQUISITES

CLASS/LAB SCHEDULE Three 60-minute class periods and one 120-minute laboratory session per week. (3-2-4)

TEXTBOOK Gene H. Miller, *Microcomputer Engineering*, 2nd ed., Prentice-Hall, 1999

REFERENCE

CREDITS Engineering Science: 3 credits; Engineering Design: 1 credit

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RELATIONSHIP TO PROGRAM OUTCOMES

CE-320 achieves the following Program Outcomes:

Primary: (a), (b), (c), (e), (k), and (l); *Secondary*: (d) and (g)

COURSE LEARNING OBJECTIVES

Each student who receives credit for CE-320 will have demonstrated the ability to do all of the tasks listed below:

1. Write assembly language programs for a atypical 8-bit computer.
2. Hand-assemble small assembly language programs into machine language.
3. Use an assembler and interpret the assembler output listing.
4. Use a debugger (e.g., set breakpoints, modify CPU and memory registers, trace execution).
5. Write assembly language programs that correctly use direct, indexed, immediate, and relative addressing modes.
6. Write structured assembly language programs.
7. Document software appropriately.
8. Use different codes (e.g., ASCII) or number representations (e.g., unsigned, two's complement, BCD) appropriately.
9. Design a system containing a combination of hardware and software.

TOPICS

1. Review of digital systems and number representation
2. Basic instructions and addressing modes
3. The condition code register and conditional branching
4. Writing programs with simple loops
5. Structured programming and top/down design
6. Arithmetic, logical, and shift instructions
7. Using the stack
8. Subroutines and parameter passing methods
9. Peripheral devices – timers and parallel I/O
10. Introduction to interrupt hardware
11. Applications of interrupt – interrupt request (IRQ) and the real-time interrupt

This syllabus was prepared by Mark Wicks   Last revised on July 14, 2000

CS-101
COMPUTING AND ALGORITHMS I

DEPARTMENT	Computer Science/Science and Math
COORDINATOR	David R. Vineyard, Assistant Professor of Computer Science
CATALOG DESCRIPTION	An introduction to algorithmic problem solving, with emphasis on elementary program and software engineering techniques. Syntax and semantics of a modern programming language; programming and debugging at the file level; true object-orientation; strings, arrays, sorting, inheritance, and exception handling.
PREREQUISITES	
CO-REQUISITES	
CLASS/LAB SCHEDULE	Three 60-minute class periods and one 120-minute laboratory session per week. (3-2-4)
TEXTBOOK	John Lewis and William Loftus*, Java Software Solutions Foundations of Program Design*, 2nd edition, Addison Wesley, 2000
REFERENCE	
CREDITS	Computer Science: 4 credits

RELATIONSHIP TO PROGRAM OUTCOMES

CS-101 achieves the following Program Outcomes:

Primary: (k) and (l)

COURSE LEARNING OBJECTIVES

Each student who receives credit for CS-101will have demonstrated the ability to do all of the tasks listed below:

1. Design, implement, compile, test, and run a computer program in a modern computer language.
2. Use a design tool for problem solving.
3. Develop an algorithm to solve a problem.
4. Decompose a problem for an effective solution.
5. Successfully input and output various types of data.
6. Write a program using appropriate documentation and style for effective communication with a human reader.
7. Define and use classes and objects.
8. Use inheritance.
9. Manipulate arrays, including sorting of values.

TOPICS

1. Programming including problem solving, program design, implementation, and testing.
2. Programming language constructs including variables, constants, literals, comments.
3. Fundamental algorithms for problem solving.
4. Programming style, white space for clarity of program.
5. Objects including inheritance, variable reference, instantiation.
6. Classes including definitions, methods, variables.
7. Input and Output.
8. Primitive data types.
9. Program statements including assignment, invocation, control flow via decision, case, and loop.
10. Boolean data, expressions, and operators.
11. Single-dimensional and multi-dimensional arrays. Vectors.
12. Sorting using well known algorithms such as bubble sort or insertion sort.
13. Classes, subclasses, polymorphic reference, class hierarchies.
14. Exception handling.

This syllabus was prepared by David Vineyard — Last revised on July 19, 2000

ECON-201
ECONOMIC PRINCIPLES

DEPARTMENT	Liberal Studies
COORDINATOR	B. Yongo-Bure, Professor of Liberal Studies
CATALOG DESCRIPTION	This course introduces the student to the economic way of thinking. Students learn how individuals, firms, and societies make choices among alternative uses of scarce resources. A survey course, it covers both introductory microeconomics and introductory macroeconomics. The course combines applied theory and policy, and equips the student with the necessary tools to analyze and interpret the market economy.
PREREQUISITES	
CO-REQUISITES	
CLASS/LAB SCHEDULE	Four 60-minute sessions per week or two 120-minute sessions per week. (4-0-4)
TEXTBOOK	Karl E. Case and Ray C. Fair, *Principles of Economics*, Prentice-Hall, 1999 James D. Gwartney and Richard L. Stroup, *Introduction to Economics*, Harcourt Brace and Company, 1994
REFERENCE	
CREDITS	General Education: 4 credits

RELATIONSHIP TO PROGRAM OUTCOMES

ECON-201 achieves the following Program Outcomes:

Primary: (d) and (j)

COURSE LEARNING OBJECTIVES

Each student who receives credit for ECON-201 will have demonstrated the ability to do all of the tasks listed below:

1. Explain the behavior of individuals, firms, and societies in their quest for economic betterment.
2. Analyze the interrelationships among the various economic entities and markets in the macroeconomy.
3. Explain the role of institutions such as the central bank and commercial banks in the economy.
4. Model a market graphically using supply and demand analysis.
5. Explain how firms maximize profits in different market structures.
6. Explain an economic dimension of a contemporary social and political issue.

TOPICS

1. The Scope and Method of Economics
2. The Economic Problem: Scarcity and Choice
3. The Structure of the U.S. Economy
4. Demand, Supply, and Market Equilibrium
5. The Price System, Supply and Demand, and Elasticity.
6. The Production Process: The Behavior of Profit-Maximizing Firms
7. Short-Run Costs and Output Decisions
8. Costs and Output Decisions in the Long Run
9. Input Demand
10. Market Structures: Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly
11. Introduction to Macroeconomics
12. Measuring National Output and National Income
13. Macroeconomic Concerns: Unemployment, Inflation, and Growth
14. Aggregate Expenditure and Equilibrium Output
15. Taxes, Spending, and Fiscal Policy
16. The Money Supply and the Federal Reserve System
17. Money Demand, The Equilibrium Interest Rate, and Monetary Policy

This syllabus was prepared by B. Yongo-Bure | Last revised on June 28, 2000

EE-210

CIRCUITS I

(Required course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Ravi Warrier, Professor of Electrical Engineering
CATALOG DESCRIPTION	This is an introductory course presenting fundamental DC and AC circuit analysis techniques. Topics include circuit variables and elements; resistors, inductors, and capacitors; and sinusoidal steady-state analysis with power calculations. Laboratory experience is designed to re-enforce the fundamental analysis techniques discussed in class.
PREREQUISITES	PHYS-224, Electricity & Magnetism PHYS-225, Electricity & Magnetism Lab
CLASS/LAB SCHEDULE	Three 60-minute class periods per week. (4-0-4)
TEXTBOOK	James W. Nilsson, *Electric Circuits*, 6th ed. Addison Wesley Publishers, 2000, (or instructor's choice)
REFERENCE	J. David Irwin, *Basic Engineering Circuits Analysis*, 5th ed. Prentice-Hall, 1996 Dorf and Svoboda*, Introduction to Electric Circuit Analysis*, 3rd ed. John Wiley and Sons, 1998
CREDITS	Engineering Science: 3.5 credits; Engineering Design: 0.5 credits

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RELATIONSHIP TO PROGRAM OUTCOMES

EE-210 achieves the following Program Outcomes:

Primary: (a), (b) and (k); *Secondary*: (c), (d), (e), (f), (h) and (i).

COURSE LEARNING OBJECTIVES

Students who receive credit for EE-210 will have demonstrated the ability to do all of the tasks listed below:

1. Describe independent and dependent sources; resistance and conductance; apply Ohm's law and Kirchoff's laws; and use color code and resistor size to determine resistance values, tolerance, and power rating.
2. Use modern measuring equipment safely, such as the oscilloscope, digital and analog meters and function generators.
3. Analyze series and parallel resistor networks and use voltage and current division concepts.
4. Apply circuit analysis techniques, including nodal and mesh analysis, source transformations, Thevenin and Norton equivalent circuits, and the principle of superposition, to solve for circuit variables.
5. Determine voltage-current relationships in capacitors and inductors and calculate the energy stored in each.
6. Define and determine sinewave parameters such as peak value, rms value, frequency, period and phase angle (leading and lagging) and dc offset.
7. Analyze impedance and model circuits with resistors, inductors and capacitors excited by sinewaves using phasors and standard circuit analysis techniques in the frequency domain.
8. Convert frequency domain phasor quantities to appropriate time domain quantities and visa versa.
9. Calculate power factor, real power and reactive power for circuits driven with sinusoidal sources.

TOPICS

1. *Circuit Variables*: units, charge, current, energy, voltage, power, passive sign convention (1 class);
2. *Circuit Elements*: independent and dependent voltage and current sources, resistance, conductance, Ohm's law, Kirchoff's laws (3 classes);
3. *Resistive Circuits*: series and parallel resistors, circuits with constant and time-varying independent sources, voltage and current division (no-load and loaded), non-ideal measurement devices (4 classes);
4. *Techniques of Circuit Analysis*: solution of simultaneous equations, nodal/mesh analysis of circuits containing resistors, independent and dependent sources, sources transformations, Thevenin and Norton equivalent circuits (with independent and dependent sources), superposition (7 classes);
5. *Inductance and Capacitance*: series and parallel inductors and capacitors, energy and power in inductors and capacitors (2 classes);
6. *Sinusoidal Steady-State Analysis*: sinusoidal signal and terminology, development of phasor techniques, Euler's identity, conversion between phasor and time domains, complex algebra, rectangular and polar conversions, impedance, reactance, susceptance, admittance, phasor equivalent circuit, phasor domain circuit analysis, Thevenin and Norton equivalent circuits in the frequency domain using phasors, real power calculations (7 classes);
7. *Sinusoidal Steady-State Power*: real and reactive power, rms value for arbitrary periodic signals, complex power, power factor, power triangle, power factor correction, maximum average power transfer (3 classes);
8. *Exams*: (3 classes).

This syllabus was prepared by Ravi Warrier — Last revised on April 2, 2003

EE-211

CIRCUITS I LABORATORY

(Required course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Ravi Warrier, Professor of Electrical Engineering
CATALOG DESCRIPTION	This is an introductory laboratory course designed to reinforce the fundamental analysis techniques discussed in EE-210, Circuits I. Topics include safe use of laboratory equipment and experimental verification of analysis techniques.
PREREQUISITES	
CO-REQUISITES	EE-210, Circuits I
CLASS/LAB SCHEDULE	One 120-minute laboratory session per week. (0-2-1)
TEXTBOOK	Handouts
REFERENCE	Textbook for EE 210, Circuits I
CREDITS	Engineering Science: 1 credit; Engineering Design: 0 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-211 achieves the following Program Outcomes:

Primary: (a), (b), and (k); *Secondary*: (c), (d), (e), (f), (h), and (i).

COURSE LEARNING OBJECTIVES

Students who receive credit for EE-211 will have demonstrated the ability to do all of the tasks listed below:

1. Safety rules of handling electrical equipment.
2. Apply Ohm's law and Kirchoff's laws; use color code and resistor size to determine resistance, tolerance, and power rating.
3. Use modern measuring equipment safely, such as the oscilloscope, digital and analog meters and function generators.
4. Analyze series and parallel resistor networks and use voltage and current division concepts, and experimentally verify the results.
5. Apply circuit analysis techniques, including nodal and mesh analysis, source transformations, Thevenin and Norton equivalent circuits, and the principle of superposition, to solve for circuit variables, and perform experimental verification.
6. Measure the sinewave parameters, such as peak value, rms value, frequency, period and phase angle (leading and lagging) and dc offset.
7. Analyze impedance and model circuits with resistors, inductors and capacitors excited by sinewaves using phasors and standard circuit analysis techniques in the frequency domain, and experimentally verify the results.
8. Convert frequency domain phasor quantities to appropriate time domain quantities and visa versa.
9. Calculate power factor, real power and reactive power for circuits driven with sinusoidal sources, and experimentally verify the results.

LABORATORY EXERCISES

1. Safety Procedures and Resistance Measurements
2. Power Supplies, Voltage and Current Measurements
3. Series and Parallel Resistances, Voltage and Current Division
4. The Oscilloscope and Function Generator
5. Mesh Current and Node Voltages
6. Thevenin and Norton Equivalent Circuits
7. Impedance Characteristics of Electrical Circuit Elements
8. Voltage and Current Phasor Relationships
9. Sinusoidal Steady-State Power
10. Practical exam or lab exercise of instructor's choice

This syllabus was prepared by Ravi Warrier Last revised on September 19, 2002

EE-230

SIGNALS AND SYSTEMS

(Required course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Laura Rust, Associate Professor of Electrical Engineering
CATALOG DESCRIPTION	Introductory continuous-time and discrete-time signals and systems are studied. Topics include: linear time-invariant systems, the Laplace transform, and the z-transform. Emphasis will be placed on applications of the theory to real systems and the use of computer simulation to verify class concepts.
PREREQUISITES	MATH-204, Differential Equations and the Laplace Transform
CLASS/LAB SCHEDULE	Four 60-minute class periods per week (4-0-4)
TEXTBOOK	Edward W. Kamen and Bonnie S. Heck, *Fundamentals of Signals and Systems*, Prentice-Hall, 1997 (or instructor's choice).
CREDITS	Engineering Science: 4 credits; Engineering Design: 0 credits

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RELATIONSHIP TO PROGRAM OUTCOMES

EE-230 achieves the following Program Outcomes:

Primary: (a) and (e). *Secondary*: (k).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-230 will have demonstrated the ability to do all of the tasks listed below:

1. Define, discuss, and plot basic continuous-time and discrete-time signals.
2. Determine the complete solution for second-order differential and difference equations using standard time-domain techniques.
3. Use the convolution integral, the convolution sum, or graphical convolution to compute the convolution of two basic signals (i.e., step, ramp, and/or pulses).
4. Determine the Laplace transform of a simple continuous-time function. Also determine the time-domain signal corresponding to a simple Laplace transform. Apply initial and final value theorems.
5. Solve second-order time-domain differential equations using the Laplace transform.
6. Determine the transfer function $H(s)$ of a continuous-time system, and plot the pole/zero diagram.
7. Determine the unilateral z-transform of a simple discrete-time function. Also determine the time-domain signal corresponding to a simple z-transform.
8. Use the unilateral z-transform to solve second-order difference equations.
9. Determine the transfer function $H(z)$ of a discrete-time system, and plot the pole/zero diagram.

TOPICS

1. *Introduction to Continuous-time and Discrete-time Signals and Systems*: Unit step function, ramp function, impulse function, rectangular function, energy, power, signal transformations, exponential and sinusoidal signals, periodic signals, step and impulse functions, basic system properties (6 classes);
2. *Linear Time-invariant Systems*: Time-domain solutions of differential and difference equations, the impulse response, the convolution integral and convolution sum for step, ramp, and pulse functions, graphical convolution for basic signals (9 classes);
3. *The Laplace Transform*: Basic Laplace transform properties and pairs, computation of inverse Laplace transform via inspection and via partial fraction expansion (for signals with real, unique roots only, Laplace transform solution to differential equations, transfer function representation of continuous-time systems ($H(s)$) the frequency response and its graphical interpretation (9 classes);
4. *The Z-Transform*: Basic one-sided z-transform pairs and properties, computation of inverse transform via power series expansion and via partial fraction expansion (for signals with real, unique roots only), z-transform solution of difference equations, transfer function representation of discrete-time systems ($H(z)$), the frequency response and its graphical interpretation (6 classes)
5. *Exams*: (3 classes)

This syllabus was prepared by Laura Rust — Last revised on April 2, 2003

EE-240
ELECTROMAGNETIC FIELDS AND APPLICATIONS
(Required course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Kenneth L. Kaiser, Associate Professor of Electrical Engineering
CATALOG DESCRIPTION	Basics of electromagnetic fields and applications are studied. Topics include: vector analysis; gradient, divergence, and curl; electrostatic fields; electrostatic boundary-value problems; magnetostatic fields; magnetic circuits; and Maxwell's equations for time-varying fields.
PREREQUISITES	PHYS-224, Electricity & Magnetism PHYS-225, Electricity & Magnetism Lab
CLASS/LAB SCHEDULE	Four 60-minute class periods per week (4-0-4)
TEXTBOOK	Mathew N.O. Sadiku, *Elements of Electromagnetics*, Saunders College Publishing, 1994 (or instructor's choice)
REFERENCE	B. S. Guru and H. Hiziroglu, *Electromagnetic Field Theory Fundamentals*, PWS Publishing Company, 1998
CREDITS	Engineering Science: 4 credits; Engineering Design: 0 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-240 achieves the following Program Outcomes:

Primary: (a). *Secondary*: (k).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-240 will have demonstrated the ability to do all of the tasks listed below:

1. Perform line, surface, and volume integrations using retangular, cylindrical, and spherical coordinate systems.
2. Define and perform the gradient, divergence, curl, and Laplacian operations.
3. Apply divergence and Stokes' theorems.
4. Define and use Coulomb's law, Gauss's law, Ampere's law, Biot-Savart's law, and Faraday's law of induction.
5. Define and use the concepts of electric and magnetic potentials, energy, and work done, electric and magnetic flux, motional emf and transformer emf.
6. Define and determine capacitance and inductance using field concepts.
7. Describe magnetic and electric field properties of materials.
8. Apply Poisson's and Laplace's equations.
9. Define and calculate conduction and convection currents and current densities.
10. Explain the equation of continuity and determine the relaxation time.
11. Analyze linear and non-linear magnetic circuits.
12. State Maxwell's equations, define their importance, and use them to determine the viability of a field.
13. Determine the relationships between field quantities on either side of a boundary using boundary conditions.
14. Define and use Poynting's theorem.
15. Express the field quantities in time and frequency domains.

TOPICS

1. Vector analysis (8 classes)
2. Electrostatic field theory and applications (10 classes)
3. Magnetostatic field theory and applications (8 classes)
4. Charge conservation and continuity equations (3 classes)
5. Maxwell's equations and applications (8 classes)
6. Exams (3 classes)

This syllabus was prepared by Bhag Guru   Last revised on August 1, 2000

EE-310
CIRCUITS II
(Required course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Laura M. Rust, Associate Professor of Electrical Engineering
CATALOG DESCRIPTION	A second course in circuit analysis. Topics include: first-order and second-order transient circuit analysis, the Fourier series, three-phase circuits, resonance, Bode plots and magnetically coupled circuits.
PREREQUISITES	EE-210, Circuits I MATH-204, Differential Equations & Laplace Transforms
CO-REQUISITES	EE-230, Signals and Systems
CLASS/LAB SCHEDULE	Four 60-minute class periods and one 120-minute laboratory session per week. (4-0-4)
TEXTBOOK	James W. Nilsson, *Electric Circuits*, 6^{th} ed. Addison Wesley Publishers, 2000, (or instructor's choice)
REFERENCE	Cunningham and Stuller, *Basic Circuits Analysis*, 2^{nd} ed. Houghton Mifflin Company, 1995
CREDITS	Engineering Science: 3 credits; Engineering Design: 1 credit

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RELATIONSHIP TO PROGRAM OUTCOMES

EE-310 achieves the following Program Outcomes:

Primary: (a) and (e). *Secondary*: (c), (f), and (l).

COURSE LEARNING OBJECTIVES

Students who receive credit for EE-310 will have demonstrated the ability to do all of the tasks listed below:

1. Analyze balanced three-phase circuits and calculate three-phase power.
2. Define series and parallel resonance of RLC circuits and calculate bandwidth and Q factor of resonant circuits.
3. Draw Bode diagrams using straight-line approximations for transfer functions with real and complex poles and zeros.
4. Obtain a circuit transfer function from Bode plots.
5. Analyze magnetically coupled circuits and determine effects of self-inductance and mutual inductance.
6. Define an ideal transformer and determine its primary side and secondary side variables.
7. Determine initial conditions and time constants for first-order and second-order circuits. Also find the natural and forced responses to step, impulse, exponential and sinusoidal inputs, using classical and the Laplace transform approach for such circuits.
8. From Bode plots, predict time domain circuit response.
9. Design first-order and second-order circuits from given specifications.
10. Design lowpass, highpass, bandstop and bandpass filters from given specifications.
11. Determine and apply the Fourier series expansion to periodic signals.

TOPICS

1. *Balanced Three-Phase Circuits*: three-phase voltage sources; wye-wye, delta-delta, wye-delta and delta-wye circuits with source, line and load impedance (6 classes)
2. *Resonance*: parallel resonance, bandwidth, Q factor, series resonance, and resonance of general circuits (4 classes)
3. *Bode Diagrams*: decibel; magnitude and phase plots; straight line approximations for nth-order real and complex poles and zeros; H(jw); lowpass, highpass, bandstop and bandpass filters; determining H(s) from a Bode plot (6 classes)
4. *Magnetically Coupled Circuits*: mutual induction, dot convention and ideal transformers (5 classes)
5. *First-Order Transient Circuit Analysis*: classical and Laplacian solutions of first-order differential equations; initial conditions; natural and forced response to step, impulse, sinusoidal and exponential inputs for RL and RC circuits; time constants;
6. *Second-Order Transient Circuit Analysis*: classical and Laplacian solutions of nth-order differential equations; natural, step, impulse, sinusoidal and exponential response of RLC circuits (6 classes)
7. *Fourier Series Analysis*: trigonometric and exponential forms; signal power; circuit response to periodic signal input (4 classes)
8. *Exams*: (3 classes)

This syllabus was prepared by Laura Rust — Last revised on July 26, 2000

EE-320
ELECTRONICS I
(Required course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	David J. Leffen, Professor of Electrical Engineering
CATALOG DESCRIPTION	The basic building blocks used in electronic engineering are studied. Topics include: operational amplifiers; diodes; bipolar and MOS devices; basic transistor configurations; bipolar and MOSFET digital logic circuits.
PREREQUISITES	EE-210, Circuits I EE-211, Circuits I Laboratory
CLASS/LAB SCHEDULE	Three 60-minute class periods per week (3-0-3)
TEXTBOOK	A. Sedra and K. Smith, *Micro-Electronic Circuits*, 4th ed. Holt, Rinehart, and Winston, 1998 (or instructor's choice)
CREDITS	Engineering Science: 2.5 credits; Engineering Design: 0.5 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-320 achieves the following Program Outcomes:

Primary: (a), (b), (c), (e), (k), and (l). *Secondary*: (d) and (g).

Course Learning Objectives

Each student who receives credit for EE-320 will have demonstrated the ability to do all of the tasks listed below:

1. Analyze and design operational amplifier circuits for a wide variety of applications.
2. Characterize and use diodes in rectifier and wave-shaping circuits.
3. Apply bipolar transistor theory to the design of switches.
4. Perform small signal analysis using bipolar transistors to determine voltage, current and power gains.
5. Apply bipolar transistors to digital logic circuits with special emphasis on the transistor-transistor logic (TTL) family.
6. Identify operating modes of field effect transistors.
7. Analyze complementary metal oxide semiconductor (CMOS) circuits.

Topics

1. Operational Amplifiers (6 classes)
2. Diodes and Nonlinear Circuit Applications (6 classes)
3. Bipolar Transistors (6 classes)
4. Bipolar Transistor Digital Logic Circuits (3 classes)
5. MOSFETs (4 classes)
6. MOSFET Digital Logic Circuits (2 classes)
7. Exams (3 classes)

This syllabus was prepared by Dave Leffen   Last revised on April 9, 2003

EE-321
ELECTRONICS I LABORATORY

(Required course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Dave Leffen, Professor of Electrical Engineering
CATALOG DESCRIPTION	This is an introductory laboratory course designed to reinforce the topics in EE-320, Electronics I. Experiments include: operational amplifiers; diodes; transistor configurations; bipolar and MOSFET digital circuits.
PREREQUISITES	EE-210, Circuits I EE-211, Circuits I Laboratory
CO-REQUISITES	EE-320, Electronics I
CLASS/LAB SCHEDULE	One 120-minute laboratory session per week. (0-2-1)
TEXTBOOK	Handouts
REFERENCE	Textbook for EE 320, Electronics I
CREDITS	Engineering Science: 0.5 credit; Engineering Design: 0.5 credits

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RELATIONSHIP TO PROGRAM OUTCOMES

EE-321 achieves the following Program Outcomes:

Primary: (a), (b), (c), (e), (k) and (l). *Secondary*: (d) and (g).

EE-321 Electronics I Laboratory
(Required course for EE)

TOPICS

Experiments on Operational Amplifiers, Diodes and Nonlinear Circuit Applications, Bipolar Transistors, Bipolar Transistor Digital Logic Circuits, and MOSFET Digital Logic Circuits.

LABORATORY EXERCISES

1. Introduction to PSPICE (1 week)
2. Operational Amplifier Circuits (2 weeks)
3. Diode Characteristic Curve and Diode Clipping Circuits (1 week)
4. Rectifiers (1 week)
5. Transistor Output Curves and Switching Circuits (1 week)
6. Transistor Biasing Circuits (1 week)
7. Transistor Small Signal Analysis Experiment and PSPICE Verification (1 week)
8. Transistor-Transistor Logic (1 week)
9. MOSFET Logic (1 week)

This syllabus was prepared by Dave Leffen   Last revised on April 9, 2003

EE-325
PRINCIPLES OF MICROELECTRONICS PROCESSING

(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Michael Elta, Visiting Professor of Electrical Engineering
CATALOG DESCRIPTION	This is an introductory course on the principles of semiconductor processing for modern integrated circuits. Topics include a brief review of semiconductor devices and semiconductor circuit families, modern CMOS technology and process flow, crystal growth, semiconductor processing, thin film deposition, oxidation, etching, lithography and an introduction to clean room principles. Principles of manufacturing process control and modeling for manufacturability will be presented. Computed simulation will be extensively used where appropriate. This course will focus on the processes needed to produce modern silicon, very large-scale integrated (VLSI) circuits. As time allows, there will be a brief introduction to additional processes needed to produce optical devices, nanotechnology, and MEMS (micro electromechanical systems) which are becoming increasingly important.)
PREREQUISITES	EE-210, Circuits I EE-211, Circuits I Lab EE-320, Electronics I EE-321, Electronics I Lab, or PHYS-342, Material Science
CLASS/LAB SCHEDULE	Four 60-minute class periods per week (4-0-4)
TEXTBOOK	James D. Plummer, Michael D. Deal, Peter B. Griffin, *Silicon VLSI Technology: Fundamentals, Practice, and Modeling*, Prentice Hall (or instructor's choice)
REFERENCE	S. Wolf and R.N. Tauber, *Silicon Processing for the VLSI Era*, Vol. 1, Process Technology, 2nd ed., Lattice Press; *VLSI Technology*, 2nd ed., edited by S.M. Sze, John Wiley; and Peter van Zant, *Microchip Fabrication*, 4th ed., McGraw Hill
CREDITS	Engineering Science: 3.5 credits. Engineering Design: 0.5 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-325 achieves the following Program Outcomes:

Primary: (a). *Secondary*: (d), (f), (h), (j), and (k).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-325 will have demonstrated the ability to do all of the tasks listed below:

1. Describe modern methods needed to manufacture silicon integrated circuits.
2. Analyze the fundamental processing methods and models.
3. Use simulators to analyze process integration issues.
4. Analyze the processes for manufacturing control.
5. Study future trends and methods for fabricating circuits of the future.

TOPICS

1. Introduction to Integrated Circuits, the Planar Process, and the Modern Clean Room (4 classes)
2. Modern CMOS Technology, Devices, and Process Flow (3 classes)
3. Crystal Growth, Wafer Fabrication and Basic Properties of Silicon Wafers (3 classes)
4. Lithography (4 classes)
5. Thin Film Deposition (4 classes)
6. Etching (4 classes)
7. Thermal Oxidation and the Si/Si02 Interface (3 classes)
8. Dopant Diffusion (3 classes)
9. Ion Implantation (3 classes)
10. Models for Process Control and Manufacturability (3 classes)
11. Novel Processing for the future (2-3 classes as time allows) (optical devices, nanotechnology, MEMS)
12. Exams (3 classes)

This syllabus was prepared by Michael Elta Last revised on April 10, 2003

EE-330

Digital Signal Processing

(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Douglas Melton, Associate Professor of Electrical Engineering
CATALOG DESCRIPTION	Basic principles, design, and applications of digital signal processing systems are presented. Topics include: review of discrete-time signals and systems, the z-transform, discrete-time Fourier analysis, the Discrete Fourier Transform, the Fast Fourier Transform, digital filter structures, FIR filters, and IIR filters. The course includes extensive use of MATLAB and experimental design projects using real-time digital signal processors.
PREREQUISITES	EE-230, Signals and Systems
CLASS/LAB SCHEDULE	Three 60-minute class periods and one 120-minute laboratory session per week. (3-2-4)
TEXTBOOK	Vinay K. Ingle and John G. Proakis, *Digital Signal Processing Using MATLAB,* Brooks/Cole Publishing Company, Pacific Grove, CA, 2000 (or instructor's choice)
REFERENCE	*The MATLAB Student Version: Learning MATLAB Version 5.3*. The MathWorks, Inc., 1999
CREDITS	Engineering Science: 2 credits; Engineering Design: 2 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-330 achieves the following Program Outcomes:

Primary: (a), (b), (c), and (e). *Secondary*: (d), (g), and (h).

EE-330, Digital Signal Processing
(Elective course for EE)

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-330 will have demonstrated the ability to do all of the tasks listed below:

1. Determine the output of discrete-time system represented as difference equation, impulse response *h(n)*, transfer function *H(z)*, or frequency response $H(e^{j!})$. Determine whether or not the system is causal and/or stable.
2. Given one system representation (i.e., a difference equation, impulse response *h(n)*, transfer function *H(z)*, or frequency response $H(e^{j!})$, convert to any of the other representations.
3. Conduct spectral analysis using Fourier methods.
4. Derive the 4-point decimation-in-time and decimation-in-frequency FFT algorithms.
5. Sketch the direct form I and direct form II filter implementation of a system.
6. Discuss multiple design techniques of FIR and IIR filters and compare and contrast their characteristics.
7. From absolute or relative filter specifications, design an arbitrary FIR or IIR filter.
8. Implement a digital filter using a real time DSP microprocessor.

TOPICS

1. Discrete-time signals and systems – Basic signals and operations, discrete-time systems and their properties, the convolution sum and graphical convolution, dime-domain solution to difference equations (3 classes)
2. z-transform – Definition, pairs and properties, the region of convergence, pole-zero diagrams and implications for stability and causality, computation of the inverse z-transform via partial fraction expansion (for unique and repeated roots, real and complex roots, and improper functions), the unilateral z-transform and its use to solve difference equations (3 classes)
3. Discrete-time Fourier analysis – the DTFT for aperiodic and periodic signals, Parseval's relationship, sampling and the Nyquist sampling theorem, analog signal reconstruction (3 classes)
4. Discrete Fourier Transform – Computing the DFT and invert DFT, zero-padding, circular convolution, the Fast Fourier Transform
5. Digital filter structures – Cascade form, parallel form, direct-form I, and direct-form II filter implementation (2 classes)
6. FIR filters – filter specifications, the frequency sampling method, Gibb's phenomenon, window design, optimal equiripple technique (6 classes)
7. IIR filters – lowpass analog filters (Butterworth, Chebyschev type I and II, Elliptical), filter digitization via bilinear transform or impulse invariance, frequency band transformation (5 classes)
8. Exams (2 classes)

LABORATORY EXERCISES

1. Audio representation of digital signals
2. Digital recording of audio signals
3. Record and filter an electrocardiogram
4. Predict machinery-bearing wear
5. Simulate room acoustics
6. Final course project of instructor's choice

This syllabus was prepared by Cynthia Finelli — Last revised on August 7, 2000

EE-340
ELECTROMAGNETIC WAVE PROPAGATION

(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Huseyin R. Hiziroglu, Professor of Electrical Engineering
CATALOG DESCRIPTION	Advanced concepts of electromagnetic fields are studied. Topics include: propagation of uniform plane waves in various material media; transmission line analysis; electromagnetic wave propagation in wave-guides; and antennas.
PREREQUISITES	EE-240, Electromagnetic Fields and Applications
CLASS/LAB SCHEDULE	Four 60-minute class periods per week (4-0-4)
TEXTBOOK	Bhag Guru and Huseyin Hiziroglu, *Electromagnetic Field Theory Fundamentals*, PWS Publishing Company, 1998 (or instructor's choice)
REFERENCE	David K. Cheng*, Field and Wave Electromagnetics*, Addison Wesley Publishers
CREDITS	Engineering Science: 4 credits; Engineering Design: 0 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-340 achieves the following Program Outcomes:

Primary: (a), (e), (h), and (i). *Secondary*: (k).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-340 will have demonstrated the ability to do all of the tasks listed below:

1. Derive wave equations for plane waves, transmission lines, wave-guides, and antennas.
2. Obtain general solutions for the wave equations in both time and phasor domains.
3. Determine the electromagnetic fields, the phase velocity, the group velocity, and wavelength of each wave.
4. Determine the transmitted and reflected fields for normally incident plane waves from one medium into another.
5. Determine voltage and current waves as a function of distance along the line.
6. Analyze multi-transmission lines.
7. Determine standing-wave ratio in a lossless medium.
8. Use Smith chart for the analysis of lossless transmission lines.
9. Define various TE and TM modes in a wave-guide and determine the expressions for the electromagnetic fields associated with them.
10. Compute the fields within a rectangular cavity for a given mode.
11. Calculate the fields associated with electrically small and large antennas.

TOPICS

1. Review of Maxwell's equations and Poynting vector in phasor domain (2 classes)
2. Plane-wave propagation (10 classes)
3. Transmission lines (6 classes)
4. Wave-guides (7 classes)
5. Antennas (5 classes)
6. Free topics (7 classes)
7. Exams (3 classes)

This syllabus was prepared by Huseyin R. Hiziroglu — Last revised on August 1, 2003

EE-342
ELECTRICAL MACHINES
(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Bhag S. Guru, Professor or Electrical Engineering
CATALOG DESCRIPTION	Operating principles and design concepts of various types of electrical machines are studied. Topics include: magnetic circuits; single-phase and three-phase transformers; dc motors and generators; three-phase alternators; synchronous motors; induction motors and single-phase motors.
PREREQUISITES	EE-240, Electromagnetic Fields and Applications EE-211, Circuits I Laboratory
CO-REQUISITES	EE-310, Circuits II
CLASS/LAB SCHEDULE	Three 60-minute class periods and one 120-minute laboratory session per week. (3-2-4)
TEXTBOOK	B.S. Guru and H.R. Hiziroglu, *Electric Machinery and Transformers*, 3rd ed. Oxford University Press, 2000 (or instructor's choice)
CREDITS	Engineering Science: 2 credits; Engineering Design: 2 credits

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RELATIONSHIP TO PROGRAM OUTCOMES

EE-342 achieves the following Program Outcomes:

Primary: (a). *Secondary*: (h), (i), and (k).

EE-342, Electrical Machines
(Elective course for EE)

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-342 will have demonstrated the ability to do all of the tasks listed below:

1. Define the differences between the ideal and non-ideal transformers.
2. Create exact and approximate equivalent circuits of a transformer and determine its efficiency and voltage regulation.
3. Connect a two-winding transformer as an autotransformer and determine its efficiency and voltage regulation.
4. Explain the construction of various types of direct-current (dc) and alternating-current (ac) machines.
5. Explain the differences between a generator and a motor.
6. Draw the equivalent circuits of dc and ac machines.
7. Obtain the performance such as voltage regulation, speed regulation, and efficiency of ac and dc machines using the appropriate equivalent circuits.
8. Draw power-flow diagrams of various types of ac and dc machines.
9. Perform experiments to determine electrical parameters of transformers, dc and ac machines.
10. Explain the revolving-field theory.

TOPICS

1. DC generators (3 classes)
2. DC Motors (3 classes)
3. Magnetic circuits and review of three-phase circuits (3 classes)
4. Single phase transformers (3 classes)
5. Autotransformers (2 classes)
6. Three-phase transformers (2 classes)
7. Three-phase alternators (5 classes)
8. Three-phase synchronous motors (3 classes)
9. Three-phase induction motors (3 classes)
10. Exams (3 classes)

LABORATORY EXERCISES

1. Determination of equivalent circuits of a single-phase induction motor under various loading conditions and correction of its power factor at full-load.
2. Magnetization characteristic of a direct-current machine and its operation as a separately-excited generator.
3. Voltage build-up, voltage regulation and operation of a direct-current shunt generator.
4. Determine the speed-torque characteristic of a separately-excited direct-current motor and examine the effects of added resistances in its armature and field-winding circuits.
5. Determination of per-phase equivalent circuits of a three-phase induction motor under various loading conditions and correction of its power factor at full-load.
6. Verification of magnetomotive force (mmf) needed to produce a given flux density in the air-gap of a magnetic circuit.
7. Determination of equivalent circuit parameters of a transformer by performing open-circuit and short-circuit tests.
8. Voltage regulation and efficiency of a two-winding transformer under various loading conditions.
9. Voltage regulation and efficiency of an autotransformer under various loading conditions.
10. Determine the equivalent circuit parameters, the voltage regulation and output characteristic of a three-phase synchronous generator.

This syllabus was prepared by Bhag Guru — Last revised on September 20, 2002

EE-344
FUNDAMENTALS OF POWER SYSTEMS

(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Huseyin R. Hiziroglu, Professor of Electrical Engineering
CATALOG DESCRIPTION	Basic structure of electrical power systems and characteristics of power transmission lines, transformers and generators are studied. Topics include: representation of power systems; symmetrical three-phase fault analysis; symmetrical components; unsymmetrical fault computations; and network analyzers.
PREREQUISITES	EE-210, Circuits I EE-211, Circuits I Lab
CLASS/LAB SCHEDULE	Three 60-minute class periods and one 120-minute laboratory session per week. (3-2-4)
TEXTBOOK	Grainger and Stevenson, *Power System Analysis*, McGraw-Hill, 1994 (or instructor's choice)
REFERENCE	W.D. Stevenson, *Elements of Power System Analysis*, McGraw-Hill, 1982 O.I. Elgerd, *Electric Energy Systems Theory: An Introduction*, McGraw-Hill, 1982
CREDITS	Engineering Science: 2 credits; Engineering Design: 2 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-344 achieves the following Program Outcomes:

Primary: (a), (b), (c), (e), (g), and (k). *Secondary*: (d), (f), (h), (i), and (l).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-344 will have demonstrated the ability to do all of the tasks listed below:

1. Analyze three-phase circuits.
2. Design a capacitor bank for power factor correction.
3. Determine parameters of transmission lines.
4. Model and design power transmission lines.
5. Use the models of transformers and generators.
6. Analyze power system using per-unit system.
7. Design and determine the performance of a power system.
8. Determine short-circuit currents for three-phase faults.
9. Use the basics of symmetrical components.
10. Determine short-circuit currents and phase voltages for unbalanced faults.
11. Design circuit breaker schemes for power systems.

TOPICS

1. Three-phase systems (2 classes)
2. Per unit systems (3 classes)
3. Transmission line parameters (4 classes)
4. Representation power lines (3 classes)
5. Synchronous machines (2 classes)
6. Transformers (2 classes)
7. System modeling and analysis (3 classes)
8. Symmetrical fault study (3 classes)
9. Symmetrical components (3 classes)
10. Unsymmetrical fault calculations (3 classes)
11. Exams (2 classes)

LABORATORY EXERCISES

1. Power factor correction
2. Three-phase power measurements
3. Experimental and numerical analysis of electric fields around a power conductor
4. Experimental study of corona activity around a conductor
5. Transmission line models
6. Measurement of partial discharges in a power cable
7. Polyphase transformer connections
8. Measurement of partial discharges in a power transformer
9. Per-unit impedances of three-winding transformers
10. Transients on synchronous machines

This syllabus was prepared by Huseyin R. Hiziroglu Last revised on July 14, 2000

EE-346
HIGH VOLTAGE GENERATION AND MEASUREMENT TECHNIQUES

(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Huseyin R. Hiziroglu, Professor of Electrical Engineering
CATALOG DESCRIPTION	Insulation overvoltage-tests are studied. Topics include: generation of high, direct, alternating, and impulse voltages; voltage multiplier circuits; resonant transformers; resistive, capacitive and mixed high-voltage dividers; sphere gaps; electrostatic voltmeters, Kerr Cell; ;and electrostatic coupling and interference.
PREREQUISITES	EE-210, Circuits I EE-211, Circuits I Lab EE-240, Electromagnetic Fields and Applications
CLASS/LAB SCHEDULE	Three 60-minute class periods and one 120-minute laboratory session per week. (3-2-4)
TEXTBOOK	E. Kuffel and W.S. Zaengl, *High Voltage Engineering Fundamentals*, Pergamon Press, 1984
REFERENCE	A. Schwab, *High Voltage Measurement Techniques*, MIT University Press, 1995
CREDITS	Engineering Science: 2 credits; Engineering Design: 2 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-346 achieves the following Program Outcomes:

Primary: (a), (b), (c), (e), (g), and (k). *Secondary*: (d), (f), (h), (i), and (l).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-346 will have demonstrated the ability to do all of the tasks listed below:

1. Understand the operating principles and design high-voltage dc, ac and impulse generators.
2. Understand the fundamentals of high-voltage measurement.
3. Understand the concept of stray capacitance and inductance in high-voltage measurement.
4. Design resistive and capacitive voltage dividers for measurement of high ac, dc and impulse voltages.
5. Calibrate spark gaps for the measurement of crest values of ac and impulse voltages.
6. Design bridge circuits for non-destructive testing of dielectrics.

TOPICS

1. General overview of the high-voltage techniques (2 classes)
2. Generation of high alternating voltage (3 classes)
3. Generation of high direct voltage (4 classes)
4. Generation of high impulse voltage (4 classes)
5. General requirements for HV measurement (1 class)
6. Impulse voltage measurements using HV dividers (5 classes)
7. Measuring devices for HVDC and impulse voltages for both peak and RMS values of AC voltages (5 classes)
8. Dielectric measurements (4 classes)
9. Exams (2 classes)

LABORATORY EXERCISES

1. Design and construction of high-voltage DC generator
2. Design and construction of Cockroft-Walton generator
3. Design and construction of a single-stage impulse-voltage generator
4. Design and construction of a multistage impulse-voltage generator
5. Small-scale model of a series-resonant circuit
6. Measurement of lightning impulse voltage using a spark gap
7. Identification of positive and negative polarity corona discharges

This syllabus was prepared by Huseyin R. Hiziroglu Last revised on Jul 14, 2000

EE-348
ELECTROMAGNETIC COMPATIBILITY

(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Ken Kaiser, Associate Professor of Electrical Engineering
CATALOG DESCRIPTION	Issues involved in designing electrical and electronic systems to achieve electromagnetic compatibility are studied. Topics include: interference sources; government regulations limiting conducted and radiated omissions; electric and magnetic field noise coupling; grounding; filtering; shielding; electrostatic discharge; spectral analysis of electromagnetic interference; design methods for minimizing radiated emissions from digital circuits; and measurement of system emissions and susceptibility.
PREREQUISITES	EE-210, Circuits I EE-240, Electromagnetic Fields and Applications
CLASS/LAB SCHEDULE	Four 60-minute class periods per week (4-0-4)
TEXTBOOK	R. Clayton, *Introduction to Electromagnetic Compatibility*, 3rd ed. Oxford University Press, 1995 (or instructor's choice)
REFERENCE	Henry W. Ott, *Noise Reduction Techniques in Electronic Systems*, 2nd ed, John Wiley & Sons, 1988
CREDITS	Engineering Science: 4 credits; Engineering Design: 0 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-348 achieves the following Program Outcomes:

Primary: (a) and (k). *Secondary*: (s).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-348 will have demonstrated the ability to do all of the tasks listed below:

1. Discuss the importance of electromagnetic compatibility, including government regulations.
2. Model nonideal response of resistors, capacitors, inductors, conductors, and cables.
3. Design simple circuits for reducing the probability of arcing of contacts.
4. Model passive probes.
5. Approximately determine the frequency spectrum of common periodic and aperiodic signal and estimate their highest frequency of interest.
6. Design simple passive RLC filters used in the modification of a signal in both the time and frequency domain.
7. Model the emissions and susceptibility of common wires and circuit board lands.
8. Design fundamental shielding schemes for electric fields, magnetic fields, and plane waves.
9. Select the "best" cable to reduce crosstalk and plane wave interference.
10. Design grounding schemes that consider both safety and electromagnetic compatibility issues, including electrostatic discharge.
11. Provide appropriate and common "fixes" used in industry to reduce and control electrical interference.

TOPICS

1. Overview of electromagnetic compatibility issues and government regulations (1 class)
2. Interference sources (2 classes)
3. Interference coupling (5 classes)
4. Design of ground systems (4 classes)
5. Electromagnetic interference filters (5 classes)
6. Radiated and conducted emissions and susceptibility (5 classes)
7. Shielding (4 classes)
8. Electrostatic discharge (4 classes)
9. Design guidelines (4 classes)
10. Measurement and testing (3 classes)
11. Exams (3 classes)

This syllabus was prepared by Ken Kaiser Last revised on April 10, 2003

EE-420
ELECTRONICS II
(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Mark G. Thompson, Professor of Electrical Engineering
CATALOG DESCRIPTION	Advanced concepts of electronic engineering are studied. Topics include: nonlinear circuits; active filters; differential and multistage amplifiers; pulse and switching circuits; integrated circuits; and electronic system design.
PREREQUISITES	EE-310, Circuits II EE-320, Electronics I EE-321, Electronics I Lab
CLASS/LAB SCHEDULE	Three 60-minute class periods and one 120-minute laboratory session per week. (3-2-4)
TEXTBOOK	A. Sedra and K. Smith, *Micro-Electronic Circuits*, 4th ed. Oxford University Press, 1998 (or instructor's choice)
CREDITS	Engineering Science: 2 credits; Engineering Design: 2 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-420 achieves the following Program Outcomes:

Primary: (a), (b), (c), (e), and (k). *Secondary*: (d), (f), (g), (i), and (l).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-420 will have demonstrated the ability to do all of the tasks listed below:

1. Demonstrate an understanding of transistor small-signal models and analysis techniques.
2. Analyze and design discrete transistor multistage amplifier.
3. Analyze basic components of multistage IC amplifiers such as bias circuits, differential stages and active loads.
4. Demonstrate a practical understanding of component selection guidelines and application for discrete circuits and IC's.
5. Analyze and design multistage IC amplifiers based on CMOS and Bipolar technologies.
6. Demonstrate the effective use of PSPICE to assist in the design of transistor amplifiers.
7. Demonstrate the ability to analyze the low and high frequency response of transistor amplifiers.
8. Demonstrate an understanding of power dissipation, power conversion efficiency, and signal distortion in Class A, B, and AB power amplifier design.
9. Analyze and design operational amplifier active filters.
10. Analyze and design comparator and limiter circuits to meet design specifications such as threshold voltage and hysteresis voltage.
11. Analyze and design timer circuits for a variety of applications.
12. Use of PSPICE to assist in design verification of electronic systems.

TOPICS

1. Discrete transistor amplifier design (4 classes)
2. Differential and multistage IC amplifiers (6 classes)
3. Amplifier frequency response (4 classes)
4. Power amplifiers (4 classes)
5. Active filters (4 classes)
6. Nonlinear wave-shaping and timing circuits (6 classes)
7. Exams (2 classes)

LABORATORY EXERCISES

1. Multistage amplifier design, simulation and testing (3 weeks)
2. Differential amplifiers, the emitted coupled pairs (2 weeks)
3. Power amplifiers, Class B and Class AB (1 week)
4. Active filter design (2 weeks)
5. Comparators and Schmitt triggers (1 week)
6. 555 Timer applications (1 week)

This syllabus was prepared by Mark G. Thompson Last revised on April 10, 2003

EE-424
POWER ELECTRONICS AND APPLICATIONS

(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Bhag S. Guru, Professor Electrical Engineering
CATALOG DESCRIPTION	Speed control and dynamic representation of electric motors are studied. Topics include: characteristics of diodes; diacs; thyristors and MOSFET's; thyristor gate firing circuits; operating principles of AC/DC, DC/DC and DC/AC converter circuits; and computer-aided state-space analysis of the dynamic response of the converter circuits.
PREREQUISITES	EE-320, Electronics I EE-321, Electronics I Lab
CLASS/LAB SCHEDULE	Three 60-minute class periods and one 120-minute laboratory session per week. (3-2-4)
TEXTBOOK	D. W. Hart, *Introduction to Power Electronics*, Prentice-Hall (or instructor's choice)
REFERENCE	Ned Mohan, Tore Undeland and William Robbins, *Power Electronics Converters Applications and Design*, John Wiley & Sons
CREDITS	Engineering Science: 2 credits; Engineering Design: 2 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-424 achieves the following Program Outcomes:

Primary: (a), (b), (c), (e), and (k). *Secondary*: (d), (f), (g), (h), and (l).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-424 will have demonstrated the ability to do all of the tasks listed below:

1. Analyze and design gating circuits using operational amplifiers, bipolar junction transistors (BJTs), MOSFETs, thyristors (SCRs) unijunction transitors (UJTs), and programmable unijunction transistors (PUTs)
2. Analyze and design ac to dc controlled and uncontrolled converters.
3. Analyze and design dc to dc converters (choppers).
4. Analyze and design dc to ac converters.
5. Analyze and design ac to ac converters.
6. Analyze and design dc power supplies using such converters as flyback converter, forward converter, and double-ended forward converter.
7. Design and verify circuits to control ac and dc machines.

TOPICS

1. Characteristics of different types of mechanical drives; characteristics of DC motors; conventional speed control methods of DC motors and their economy (3 classes)
2. Dynamics of DC motors; dynamical representation of the motor-load system using state-space approach; block diagram representation of the motor-load system using Laplace-transform technique; computer-aided analysis of the dynamic response of the motor (7 classes)
3. Introduction to the electronic devices for motor control; Physical structure of diodes and thyristors: AC to DC converters; analysis of silicon-controlled rectifier (thyristors) circuits with static resistive and inductive loads; analysis of AC to DC thyristor converters for speed control of DC motors; MOSFET circuits (6 classes)
4. DC to DC converters (choppers); general principles of thyristor chopper circuits; pulse-width-modulation and pulse-frequency modulation (5 classes)
5. DC to AC converters (inverters); speed control of AC motors; principles of inverter circuits; thyristor inverter circuits as applied to AC motor control; thyristor inverter circuits as applied to AC motor control (3 classes)
6. Brushless motors (3 classes)
7. Exams (3 classes)

LABORATORY EXERCISES

1. Design and implement AC/DC uncontrolled single-phase and three-phase converters with static loads
2. Design and implement AC/DC controlled single-phase and three-phase converters with static loads
3. Design and implement AC/DC converter to drive a shunt-excited dc motor
4. Design and implement a chopper circuit
5. Design and implement a dc power supply using flyback converter
6. Project

This syllabus was prepared by Bhag Guru — Last revised on April 9, 2003

EE-426
SOLID STATE DEVICES

(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Mark G. Thompson, Professor of Electrical Engineering
CATALOG DESCRIPTION	Basic semiconductor theory for solid-state devices, diode theory, and applications of theory for transistors are studied. Topics include: energy bands, carrier statistics, equilibrium carrier concentrations, carrier transport, electrostatic devices, diode I-V characteristics and BJT, JFET, MESFET and MOSFET transistor models.
PREREQUISITES	EE-310, Circuits I EE-320, Electronics I
CLASS/LAB SCHEDULE	Three 60-minute class periods and one 120-minute laboratory session per week. (3-2-4)
TEXTBOOK	Robert F. Pierret, *Semiconductor Device Fundamentals*, Addison-Wesley, 1996
CREDITS	Engineering Science: 2 credits; Engineering Design: 2 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-426 achieves the following Program Outcomes:

Primary: (a), (b), (c), and (e). *Secondary*: (d), (g), (h), (i), (j), and (k).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-426 will have demonstrated the ability to do all of the tasks listed below:

1. Describe the crystal structure of common semiconductors and explain the quantization concept and the meaning of energy gap.
2. Compute the equilibrium carrier concentrations of non-degenerately doped semiconductors and explain the development of the carrier model upon which the computations are based.
3. Explain the difference between the drift and diffusion current and the roles that they play in device operation.
4. Describe the basic steps of semiconductor device fabrication.
5. Analyze the electrostatics of step-graded and linear-graded p-n junctions.
6. Analyze the I-V characteristics of p-n junctions.
7. Characterize p-n junction diodes by making I-V and C-V measurements.
8. Describe fundamental bipolar junction transistor operation.
9. Analyze and measure the basic terminal I-V characteristics of bipolar junction transistors.
10. Describe the structure and explain the operation of basic MOSFET devices.
11. Describe the factors that influence MOS threshold voltage and perform C-V measurements to verify theory.

TOPICS

1. Semiconductor Fundamentals: crystal structure, energy band concepts, Fermi energy, carrier concentrations, carrier transport (6 classes)
2. P-N Junction Diodes: equilibrium conditions, the diffusion equation, forward and reverse characteristics for ideal diode, deviations from ideal, junction admittance, switching behavior (6 classes)
3. Metal-Semiconductor Contacts: Schottky barriers, Ohmic contacts (1 class)
4. Bipolar Junction Transistors: fundamental operation, derivation of terminal I-V equations, input and output characteristics, small signal models, large signal switching behavior (6 classes)
5. Junction Field Effect Transistors: qualitative description, first order I-V model, metal semiconductor FET (2 classes)
6. Metal-Oxide-Semiconductor Field Effect Transistors: basic operation, MOS capacitor, threshold voltage, substrate bias effects, short channel effects (6 classes)
7. Exams (3 classes)

LABORATORY EXERCISES

1. Wafer probe station measurements, computer data acquisition, and curve trace I-V
2. Majority carrier type and resistivity measurements, four point probe
3. Hall effect mobility measurement
4. Temperature stimulated capacitance and current measurements, deep level impurities
5. Junction diode I-V and photocurrent measurements
6. Junction diode C-V measurements
7. Large signal junction diode transient behavior
8. Static bipolar junction transistor characteristics
9. MOS diode C-V measurements
10. Static MOSFET characteristics

This syllabus was prepared by Mark G. Thompson — Last revised on April 9, 2003

EE-428
VLSI DESIGN
(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	David J. Leffen, Professor of Electrical Engineering
CATALOG DESCRIPTION	Design techniques and basic theory of integrated circuit design are discussed. Topics include: review of the semiconductor physics associated with NMOS and CMOS; NMOS and CMOS circuits; CMOS logic forms; stick diagrams and combinational networks; fabrication techniques; layout techniques using CAD tools; circuit extraction and analysis; standard cell design; introduction to VHDL and application design using VHDL memory devices including RAMs and ROMs; various registers including dynamic latches; Field Programmable Gate Arrays; and reliability of VLSI devices and systems. An integrated circuit project is completed.
PREREQUISITES	CE-210, Digital Systems I EE-320, Electronics I
CLASS/LAB SCHEDULE	Three 60-minute class periods and one 120-minute laboratory session per week. (3-2-4)
TEXTBOOK	M.J.S. Smith, *Application-Specific Integrated Circuits*, Addison-Wesley, 1997
REFERENCE	A.M. Dewey, *Analysis and Design of Digital Systems with VHDL*, PWS Publishing Company, 1997; M. Sarrafzadeh and C. Wong, *An Introduction to VLSI Physical Design*, McGraw-Hill, 1996
CREDITS	Engineering Science: 3 credits; Engineering Design: 1 credit

RELATIONSHIP TO PROGRAM OUTCOMES

EE-428 achieves the following Program Outcomes:

Primary: (a), (b), (c), (e), and (k). *Secondary*: (e), (f), (g), (h), and (i).

EE-428, VLSI Design
(Elective course for EE)

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-428 will have demonstrated the ability to do all of the tasks listed below:

1. Analyze and develop strategies for modifying semiconductor processes to required specifications.
2. Design and simulate complex CMOS circuits.
3. Layout custom integrated circuits using a systematic design process.
4. Select appropriate memory technologies for various applications.
5. Select appropriate fast prototyping methods from programmable logic arrays, gate arrays, and field programmable gate arrays.
6. Perform cost benefit analyses on various technologies.
7. Perform a reliability analysis on a complex electronic system.
8. Develop thermal analysis methods for electronic systems.

TOPICS

1. Review of NMOS, PMOS, and CMOS device physics (5 classes)
2. Integrated circuit fabrication and packaging techniques (5 classes)
3. Analysis of NMOS and CMOS logic circuits (3 classes)
4. CMOS logic forms using general representations, stick diagrams, combinational networks (3 classes)
5. Layout techniques using CAD tools, circuit extraction and analysis, standard cell design (3 classes)
6. Memory devices including RAM's, ROM's various registers, including dynamic latches (3 classes)
7. Fast prototyping methods, including programmable logic arrays (PLA), gate arrays, and field programmable gate arrays (FPGA) (3 classes)
8. Use of VHDL in designing ASIC's and FPGA circuits (3 classes)
9. Floor planning and power distribution (3 classes)
10. Exams (2 classes)

LABORATORY EXERCISES

1. Tutorial introducing the Design Architect system from Mentor Graphics
2. Schematic capture project using Design Architect; Simulation is achieved using QuicksimII
3. Introduction to VHDL using the same schematic capture project mentioned above
4. Design of a traffic light controller using VHDL
5. Introduction to IC station (custom layout system)
6. Custom layout of a logic circuit
7. A major open-ended design project to be implemented using VHDL

This syllabus was prepared by David J. Leffen — Last revised on April 9, 2003

EE-430
COMMUNICATION SYSTEMS
(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Doug Melton, Associate Professor of Electrical Engineering
CATALOG DESCRIPTION	The study of methods used in electronic communication systems. Topics include: Fourier Transforms; analysis of distortion over a communication channel; autocorrelation of deterministic and random signals; energy and power spectral density; amplitude modulation; frequency modulation; phase modulation; digital line coding and modulation; communication circuitry.
PREREQUISITES	EE-230, Signals and Systems EE-310, Circuits II EE-320, Electronics I Math-408, Probability & Statistics
CLASS/LAB SCHEDULE	Four 60-minute class periods per week (4-0-4)
TEXTBOOK	B.P. Lathi, *Modern Digital and Analog Communication Systems*, 3rd ed. Oxford University Press (or instructor's choice)
REFERENCE	L. Couch, *Digital and Analog Communication Systems*, 5th ed. Prentice Hall
CREDITS	Engineering Science: 3 credits; Engineering Design: 1 credit

RELATIONSHIP TO PROGRAM OUTCOMES

EE-430 achieves the following Program Outcomes:

Primary: (a), (c), (e), and (k). *Secondary*: (f), (g), (h), and (i).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-430 will have demonstrated the ability to do all of the tasks listed below:

1. Identify fundamental circuit building blocks in a communication system.
2. Relate common signal processing operations in communication systems to Fourier transforms.
3. Relate common signal processing operations in communication systems to electronic circuits.
4. Determine the effects of a linear transfer function on a communication signal.
5. Determine the spectra and energy spectral density of finite duration waveforms using the Fourier transform.
6. Determine the power spectral density of random processes through a Fourier transform of an auto-correlation.
7. Determine the time-domain form and spectral content or estimate the spectral content for the following methods of modulation and line encoding: (a) DSB-SC (Double Side-Band, Suppressed carrier, (b) Standard AM (Amplitude Modulation); (c) QAM (Quadrature Amplitude Modulation); (d) SSB-AM (Single Side-band Amplitude Modulation); (e) VSB (Vestigial Side-band); (f) FM (Frequency Modulation): (g) PM (Phase Modulation); (h) Unipolar Line Coding; (i) Bipolar Line Coding; (j) Manchester Line Coding; (k) BPSK (Binary Phase Shift Keying); (l) FSK (Frequency Shift Keying)

TOPICS

1. Review of Fourier Series Analysis and Linear Systems (4 classes)
2. Fourier Transforms (4 classes)
3. Fundamental Signal Processing for Communications and the Application of Fourier Transforms (3 classes)
4. Energy and Power Spectral Density (1 class)
5. Autocorrelation of Random Processes (3 classes)
6. AM Methods, Modulation, Demodulation, Circuitry (4 classes)
7. FM Methods, Modulation, Demodulation, Circuitry (4 classes)
8. Line Encoding (4 classes)
9. Bandpass Digital Methods (4 classes)
10. Exams and Quizzes (3 classes)
11. Laboratory Experiments (4 classes)
12. Free Topics (2 classes)

This syllabus was prepared by Doug Melton   Last revised on April 9, 2003

EE-432
FEEDBACK CONTROL SYSTEMS
(*Elective course for EE)*

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	David J. Leffen, Professor of Electrical Engineering
CATALOG DESCRIPTION	Time and frequency domain representations of control systems are studied. Topics include: stability criteria; root locus methods; frequency response techniques; s-plane design methods. Design and evaluation of control systems are supplemented with computer aided control system design software.
PREREQUISITES	EE-310, Circuits II EE-320, Electronics I EE-321, Electronics I Lab
CLASS/LAB SCHEDULE	Three 60-minute class periods and one 120-minute laboratory session per week. (3-2-4)
TEXTBOOK	Katsuhiko Ogata, *Modern Control Engineering*, 3rd ed. Prentice-Hall, 1997 (or instructor's choice)
REFERENCE	Richard C. Dorf and Robert H. Bishop, *Modern Control Systems*, 8th ed. Addison Wesley, 1998; MATLAB and Simulink, The Math Works, Inc.
CREDITS	Engineering Science: 2 credits; Engineering Design: 2 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-432 achieves the following Program Outcomes:

Primary: (a), (b), (c), (e) and (k); Secondary: (g) and (i)

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-432 will have demonstrated the ability to do all of the tasks listed below:

1. Recognize the symbols for the different parts of a block diagram: functional blocks, summing blocks and branch points. Simplify a block diagram using block diagram algebra to obtain a transfer function between any two points in the diagram.
2. Model a mechanical system consisting of masses, dampers and springs in the form of a transfer function. Model an electrical system consisting of inductors, resistors, capacitors and operational amplifiers in the form of a transfer function.
3. Determine the impulse, step, and ramp response of a system, given a transfer function model.
4. Calculate the delay time, rise time, peak time, maximum overshoot and settling time for a step response, given the transfer function. Estimate the transfer function from a plot of the output.
5. Perform Routh's stability criterion to determine if a system is stable. For systems with unknown values, determine the range of values for which the system will be stable.

COURSE LEARNING OBJECTIVES (continued)

6. Recognize the "type" of a system (based on the number of free integrators) and discuss the expected error characteristics as related to step, ramp, and acceleration inputs.
7. Sketch the root locus of a system. Explain how adding a pole or a zero affects the root locus.
8. Interpret design criteria as related to the closed loop pole location on the complex plane. Design requirements such as maximum overshoot, settling time, static velocity error and undamped natural frequency should be interpreted.
9. Identify a lead network, a lag network, and a lead-lag network in terms of the pole and zero locations on the complex plane.
10. Determine a pole or zero location so that the root locus passes through a particular point on the complex plane. Determine the gain value which corresponds to a location on the root locus.
11. Draw the Bode plot (magnitude and phase) for a transfer function. Determine the frequency where the magnitude is 0dB. Comment on the deviations from the straight line approximations as they relate to a single pole or zero, and to complex poles and zeros.
12. Construct the Nyquist plot. Show the direction of the Nyquist path; label critical frequencies and amplitudes. Determine a system's closed loop stability based on the Nyquist plot.
13. Interpret design requirements such as bandwidth, gain margin, phase margin, and velocity error constant as they relate to frequency domain design methods.
14. Design a compensator in the frequency domain to meet specific design requirements using a lead compensator, lag compensator, or lead-lag compensator.

TOPICS

1. Introduction to control systems: elements of a control system, standard terminology, block diagram manipulation (3 classes)
2. Modeling of physical systems: obtaining a transfer function for practical systems, modeling some nonlinearities, numerical simulation tools (5 classes)
3. Performance criteria: overshoot, settling time, rise time, steady-state error (5 classes)
4. Root-locus techniques: Routh-Hurwitz criteria, construction of the root locus, stability analysis using the root locus, root locus based control system design using lead, lag, and PID compensation (6 classes)
5. Frequency response methods: review of Bode plots, Nyquist plots, performance specifications and stability analysis in the frequency domain, and frequency response based control system design using lead, lag, and PID compensation (8 classes)
6. Exams (3 classes)

LABORATORY EXERCISES

1. Modeling control system components (2 weeks)
2. Frequency response and operational amplifier circuits
3. Velocity feedback
4. Position feedback
5. Root locus study
6. Velocity control system design
7. Position control system design
8. Ball and beam control system design (2 weeks)

This syllabus ws prepared by Dave Leffen Last revised on April 9, 2003

EE-444

COMPUTATIONAL METHODS IN POWER SYSTEMS

(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Huseyin R. Hiziroglu, Professor of Electrical Engineering
CATALOG DESCRIPTION	Matrix analysis of power system networks is studied. Topics include: power flow study of large scale interconnected power systems using Gauss-Seidel and Newton-Raphson methods; computer-aided short circuit analysis of large systems; economic operation of power networks; transient stability analysis; overvoltage calculations; and fundamentals of power system protection.
PREREQUISITES	EE-344, Fundamentals of Power Systems
CLASS/LAB SCHEDULE	Four 60-minute class periods per week (4-0-4)
TEXTBOOK	Grainger and W.D. Stevenson, Jr., *Power System Analysis*, McGraw-Hill, 1994 (or instructor's choice)
REFERENCE	W.D. Stevenson, Jr., *Elements of Power System Analysis*, McGraw-Hill, 1982; O.I. Elgerd, *Electric Energy Systems Theory: An Introduction*, McGraw-Hill, 1982
CREDITS	Engineering Science: 2 credits; Engineering Design: 2 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-444 achieves the following Program Outcomes:

Primary: (a), (c), (e), and (k). *Secondary*: (f), (h), and (i).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-444 will have demonstrated the ability to do all of the tasks listed below:

1. Develop general power flow equations (PFE) for an n-bus power system.
2. Solve PFE using algorithms such as Gauss-Seidel and Newton-Raphson.
3. Design a power system for a given operation condition.
4. Calculate short circuit currents in large power systems using modern algorithms.
5. Determine optimum operation for a power system.
6. Design a power system by optimizing the overall operating cost subject to pre-specified constraints.
7. Determine the transient stability of a power system.
8. Use the principles of power system protection.

TOPICS

1. Review of Matrix algebra as applied to circuit theory (2 classes)
2. Determination of power flow equations (PFE) 3 classes)
3. Computer solution of PFE using Gauss-Seidel and Newton-Raphson algorithms (15 classes)
4. Short circuit calculations for large systems using computational methods (7 classes)
5. Optimum operation of power systems (5 classes)
6. Transient stability of power systems (3 classes)
7. Overvoltages and system protection (3 classes)
8. Exams (2 classes)

This syllabus was prepared by Huseyin R. Hiziroglu Last revised on April 10, 2003

EE-490
SENIOR ELECTRICAL ENGINEERING DESIGN

(Required course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Mark G. Thompson, Professor of Electrical Engineering
CATALOG DESCRIPTION	Students will design, implement, document, and present a device or system as a significant capstone project. The project will emphasize electrical engineering, but will be multidisciplinary.
PREREQUISITES	EE-210, Circuits I EE-211, Circuits I Lab EE-230, Signals & Systems EE-240, Electromagnetic Fields & Applications EE-310, Circuits II EE-320, Electronics I EE-321, Electronics I Lab CE-210, Digitals I CE-320, Microcomputers I
CLASS/LAB SCHEDULE	Two 60-minute class periods and one 240-minute laboratory session per week. (2-4-4)
TEXTBOOK	Project Dependent
REFERENCE	Project Dependent
CREDITS	Engineering Science: 0.5 credits; Engineering Design: 3.5 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-490 achieves the following Program Outcomes:

Primary: (a), (b), (c), (d), (e), (g), (h), (i)), (k), and (l); *Secondary*: (f).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-490 will have demonstrated the ability to do all of the tasks listed below:

1. Write an appropriate engineering proposal.
2. Marshal relevant facts from disparate sources including libraries and the Internet.
3. Synthesize marshaled relevant facts and experience into a design in a cooperative and symbiotic fashion.
4. Allocate and schedule time, effort, and team members so as to accomplish the design within the existing limitations.
5. Iterate the design as new information or problems are encountered or found.
6. Write a comprehensive report.
7. Participate in the presentation and demonstration of the design project.

TOPICS

1. Presentation by the faculty of alternative projects and the forming of groups (2 classes)
2. Presentation by the faculty of topics of general interest (such as soldering techniques, resources available at Kettering University, and discussion of different kinds of components) and topics directed to, and tailored to the class project. The latter is expected to include a list of relevant Internet sites. (2 classes)
3. Most of the remaining class periods will be used for faculty monitoring of the progress of groups and assistance as appropriate. Groups are expected to work outside of the scheduled class period.
4. At the end of the semester, each group shall present a talk that includes the design, the performance, and a demonstration of the end result. Each member of the group shall participate in the presentation and demonstration. A final, written report from each group is also due at the end of the semester.

This syllabus was prepared by Mark G. Thompson Last revised on April 10, 2003

EE- 499
ELECTRICAL ENGINEERING INDEPENDENT STUDY

DEPARTMENT	Electrical & Computer Engineering
COORDINATOR	Ravi Warrier, Professor of Electrical Engineering
CATALOG DESCRIPTION	The student completes a self-directed study project in an area of interest related to Electrical Engineering. Each independent study must be based on a written proposal approved by the EE curriculum committee and a faculty advisor who will be responsible for guiding the student in the study and assessing the student's performance.
PREREQUISITES	Approval by the instructor and the EE program director.
CO-REQUISITES	
CLASS/LAB SCHEDULE	Individually Arranged
TEXTBOOK	Project Dependent
REFERENCE	
CREDITS	4 credits: Engineering Science and Design content dependent on project.

RELATIONSHIP TO PROGRAM OUTCOMES

Each independent study proposal approved by the EE program director includes a statement describing the relationship of the project to the Electrical Engineering Program outcomes.

COURSE LEARNING OBJECTIVES

Each independent study proposal approved by the EE program director includes a statement of the course learning objectives to be achieved in the course of the project. In order to successfully complete the project and receive credit for EE-499, the student must achieve all learning objectives stated in the proposal.

TOPICS

Each independent study proposal approved by the EE program director includes a list of the specific topics to be studied during the course of the project.

This syllabus was prepared by Ravi Warrier — Last revised on July 14, 2000

Course Learning Objectives

Each student who receives credit for CE- will have demonstrated the ability to do all of the tasks listed below:

1. xxx.

Topics

1. xxx

This syllabus was prepared by Last revised on July 14, 2000

EE-520

ELECTRONIC CIRCUITS AND SYSTEMS

(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	James C. McLaughlin, Associate Professor of Electrical Engineering
CATALOG DESCRIPTION	Advanced analysis and synthesis of linear and nonlinear electronic circuits, and electronic systems in a course tailored to the needs of the students and the experience of the teacher. Circuits could include: communication election circuits such as RF amplifiers, modulators, mixers, oscillators, frequency synthesizers, and detectors; and low frequency electronic circuits such as linear and switching power supplies, audio power amplifiers, and operational amplifiers. Systems include combining electronic circuits to effect a goal. Tools include PSPICE.
PREREQUISITES	EE-310, Circuits II EE-420, Electronics II
CLASS/LAB SCHEDULE	Three 60-minute class periods and one 120-minute laboratory session per week. (3-2-4)
TEXTBOOK	Instructor's Notes
CREDITS	Engineering Science: 2 credits; Engineering Design: 2 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-520 achieves the following Program Outcomes:

Primary: (a), (b), (c), (e), and (k). *Secondary*: (d), (g), (g), (i), and (l).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-520 will have demonstrated the ability to do all of the tasks listed below:

1. Analyze advanced electronic circuits.
2. Complete a report that explains the operation of one advanced electronic system.
3. Use PSPICE to analyze advanced electronic circuits effectively and appropriately.
4. Synthesize certain electronic systems or circuits.

TOPICS

Special nature of this course: The teacher will tailor the course so as to make good use of his or her experience and so as to satisfy the topical desires of the students. The exact topics covered are expected to vary. Example systems: maximizing signal-to-noise ratio in a receiving system by design; external noise; antenna noise; noise figure; noise from non-linear effects; effects of filter; detector effects. Example Topics:

1. High-frequency amplifier
2. Low noise amplifiers
3. Mixers
4. Oscillators
5. A receiver system including demodulation
6. Frequency synthesizer
7. Linear and switching power supplies
8. Power amplifiers

LABORATORY EXERCISES

The special nature of this course, wherein it is expected that the teacher will tailor course so as to make good use of his or her experience and so as to satisfy the topical desires of the students, calls for a special laboratory experience. An initial set of laboratory tasks will be crafted that are designed to cause the student to understand some of the fundamentals of the advanced electronic subject or subjects selected for study, and that are designed to have the student learn the measurement techniques needed. Following the initial set of laboratory tasks, students in small teams will design, construct, measure, verify, and present a written and oral report on an advanced electronic system (or sub-system) that is assigned by the teacher.

This syllabus was prepared by James C. McLaughlin — Last revised on April 10, 2003

EE-530
DIGITAL CONTROL SYSTEMS

(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Karen I. Palmer, Associate of Electrical Engineering
CATALOG DESCRIPTION	Control of continuous-time processes using computer-based controllers is studied. Topics include: design of control algorithms for implementation on digital computers; modeling of discrete-time systems; application of z-transforms; stability analysis; root locus analysis; controller design via conventional techniques; state-space analysis and modeling; and design of control systems using state space methods. Implementation of real-time digital controllers is performed in the lab.
PREREQUISITES	EE-432, Feedback Control Systems
CLASS/LAB SCHEDULE	Three 60-minute class periods and one 120-minute laboratory session per week. (3-2-4)
TEXTBOOK	Franklin and Powell, *Digital Control of Dynamic Systems*, McGraw-Hill (or instructor's choice)
CREDITS	Engineering Science: 2 credits; Engineering Design: 2 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-530 achieves the following Program Outcomes:

Primary: (a), (b), (c), (e), (k), and (l). *Secondary*: (g) and (i).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-530 will have demonstrated the ability to do all of the tasks listed below:

1. Model simple discrete-time linear systems in terms of difference equation.
2. Model a linear system in z-domain.
3. Analyze a hybrid control system consisting of analog and digital systems.
4. Determine the sampling time to be chosen for the digital controller.
5. Determine the stability of a digital control system by determining the poles of the transfer function.
6. Determine stability of control systems using root locus of the discrete-time system transfer function.
7. Determine the frequency response and predict the system behavior.
8. Design digital controller by mapping from s-plane to z-plane.
9. Design digital controller directly in z-domain, using root locus, and frequency response method.
10. Obtain state-space model for discrete-time system.
11. Design simple controllers using state-space approach.

TOPICS

1. Modeling of discrete-time systems using z-transforms (3 classes)
2. Discrete-time approximation of analog systems (3 classes)
3. Analysis of discrete-time systems (6 classes)
4. Design of discrete-time controllers (8 classes)
5. State space modeling of control systems (4 classes)
6. Design of control system using state space methods (4 classes)
7. Exams (2 classes)

LABORATORY EXERCISES

1. Introduction to laboratory data acquisition and computer systems (1 week)
2. Real-time implementation and analysis of dynamics of digital filters (2 weeks)
3. Frequency response analysis (1 week)
4. Design and implementation of digital controllers using mapping (2 weeks)
5. Root locus analysis (1 week)
6. Design and implementation of digital controllers using root locus method (1 week)
7. Design and implementation of digital controllers using frequency domain approach (2 weeks)

This syllabus was prepared by Karen Palmer — Last revised on April 11, 2003

EE-580
AUTOMOTIVE ELECTRONIC SYSTEMS

(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Mark Thompson, Professor of Electrical Engineering
CATALOG DESCRIPTION	Practical application of contemporary electronic control techniques to selected automotive systems, including engine control and chassis control systems, are studied. Topics include: basic coverage of electronic circuits, microprocessors, and feedback control systems; practical application of these principles to automotive electrical systems including power and signal distribution, electronic ignition, and charging and voltage regulation systems; automotive sensors and actuators, engine management systems, and antilock brake systems.
PREREQUISITES	EE-320, Electronics I EE-432, Feedback Control Systems or ME-430, Dynamic Systems II
CLASS/LAB SCHEDULE	Three 60-minute class periods and one 120-minute laboratory session per week. (3-2-4)
TEXTBOOK	Instructor's Notes
CREDITS	Engineering Science: 2 credits; Engineering Design: 2 credits

RELATIONSHIP TO PROGRAM OUTCOMES

EE-580 achieves the following Program Outcomes:

Primary: (a), (b), (c), (e), (k), and (l). *Secondary*: (f), (g), (h), and (i).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-580 will have demonstrated the ability to do all of the tasks listed below:

1. Describe the functionality and integration of various electronic systems of a vehicle, including Vehicle Electrical System, Automotive Instrumentation System, Engine/Powertrain Management Systems, Chassis Electronic System and Body Electronic System.
2. Analyze and simulate fundamental electrical and electronic circuits associated with present and future automotive electronic systems.
3. Apply basic electrical engineering concepts to the design of automotive electrical power generation, charging, and voltage regulation systems.
4. Describe microprocessor technology and peripherals used in automotive microcontroller systems.
5. Describe real-time control strategies, algorithm computation vs. table look-up and interpolation, distributed processing strategies, serial data communication issues, bus loading and latency, fault tolerance and diagnostic principles.
6. Analyze and simulate fundamental control system models of vehicle systems using MATLAB. Draw block diagrams of representative control systems. Perform stability and frequency response analyses and simulations.
7. Describe a cruise control case study.
8. Describe the basic principles and electronic circuits associated with automotive sensors and actuators. Discuss future trends in sensing and overall hardware strategy.
9. Discuss the fundamental principles of electronic engine control and the control strategies employed.
10. Describe methods of regulating air and fuel intake and ignition spark timing to achieve desired engine performance in terms of output power, fuel consumption, and emissions.
11. Describe a case study of a fuel control system and an ignition control system.
12. Describe a lambda control system that maintains stoichiometry in combustion chamber.

TOPICS

1. Automotive Electrical and Electronic Functions and Controls Overview (1 class)
2. Electrical and Electronic Systems Concepts (3 classes)
3. Automotive Electrical Systems (3 classes)
4. Microprocessor Concepts (3 classes)
5. Control System Concepts (3 classes)
6. Automotive Sensors and Actuators (3 classes)
7. Basic Engine Control System Concepts (3 classes)
8. Fuel Control Systems (3 classes)
9. Ignition Control Systems (3 classes)
10. Lambda Control (3 classes)
11. Exams (2 classes)

LABORATORY EXERCISES

1. Software familiarization (ASCET-SD, INCA, LabCar)
2. A basic limit-cycle controller-cooling fan on/off/hysteresis
3. Sensors: Thermistors, Hall-effect, Magnetic Reluctance
4. DC Motor Control: PWM
5. Power window controller
6. Electronic throttle control
7. LabCar simulation, idle speed control
8. LabCar simulation cruse control

This syllabus was prepared by Mark Thompson — Last revised on April 11, 2003

EE-584 WIRELESS COMMUNICATIONS FOR AUTOMOTIVE APPLICATIONS

(Elective course for EE)

DEPARTMENT	Electrical and Computer Engineering
COORDINATOR	Douglas Melton, Associate Professor of Electrical Engineering
CATALOG DESCRIPTION	This course includes the description, analysis, selection and design of wireless communication systems, particularly those for automotive applications. The topics of the course include familiarization with practical methods of wireless communications as well as development of skills necessary to assess and select a preferred method. Practicality and analysis of simple systems form the focus of the course.
PREREQUISITES	EE-430, Communication Systems
CLASS/LAB SCHEDULE	Four 60-minute class periods per week (4-0-4)
TEXTBOOK	Instructor's Choice
CREDITS	Engineering Science: 3 credits; Engineering Design: 1 credit

RELATIONSHIP TO PROGRAM OUTCOMES

EE-584 achieves the following Program Outcomes:

Primary: (a), (c), (e), and (k). *Secondary*: (b), (f), (h), (i), and (l).

COURSE LEARNING OBJECTIVES

Each student who receives credit for EE-584 will have demonstrated the ability to do all of the tasks listed below:

1. Identify fundamental circuit building blocks in a wireless communication system.
2. Relate wireless communication systems to electronic circuits and devices.
3. Determine an appropriate frequency, modulation antenna for an RF wireless communication system.
4. Determine the design parameters that govern the performance of an RF or infrared wireless communication system.

TOPICS

1. Introduction to Wireless Communication Systems (2 hours)
2. Bandwidth requirements for various sources and signals (1 hour)
3. Digital communication modulation methods and components (5 hours)
4. Error corrective coding (3 hours)
5. Methods of Mux/Multiple access (TDMA, FDMA, CMDA) (3 hours)
6. Noise sources, noise figure (3 hours)
7. RF propagation models (3 hours)
8. Multipath and Rayleigh fading, doppler effect (3 hours)
9. RF Antennas: Selection, overall characteristics, including polarity, directivity, gain (4 hours)
10. RF case study (2 hours)
11. Fundamental understanding of current technologies and standards (2 hours)
12. Infrared communications (4 hours)
13. Laboratory project description/student presentations (3 hours)
14. Examination (2 hours)

This syllabus was prepared by Douglas Melton　　　　Last revised on April 11, 2003

HUMN-201

INTRODUCTION OF THE HUMANITIES

DEPARTMENT	Liberal Studies
COORDINATOR	John Darscheid, Associate Professor of Liberal Studies
CATALOG DESCRIPTION	The humanities are disciplines focused on the study of literature, philosophy, and the arts. This course is designed to introduce students to the humanities by the examination of selected works in drama, fiction, poetry, philosophy, and the fine arts. Formal graded writing assignments will be integrated into the course.
PREREQUISITES	COMM-101, Written & Oral Communication I
CO-REQUISITES	
CLASS/LAB SCHEDULE	Four 60-minute sessions per week or two 120-minute sessions per week. (4-0-4)
TEXTBOOK	Fleming, *Arts and Ideas* (common textbook) One major reading in common of philosophy/aesthetics/criticism, e.g. Plato's *Phaedrus* One major reading in common of literature, e.g. Shakespeare's *Hamlet* Other readings to be assigned at the discretion of the instructor.
REFERENCE	
CREDITS	General Education: 4 credits

RELATIONSHIP TO PROGRAM OUTCOMES

HUMN-210 achieves the following Project Outcomes:

Primary: (d), (g), and (j); *Secondary*:

Course Learning Objectives

Each student who receives credit for HUMN-201 will have demonstrated the ability to do all of the tasks listed below:

1. Understanding of literary and artistic conventions
2. Understanding of philosophical issues and approaches
3. Understanding of the development of aesthetics and ideas over time
4. Improvement of writing skills

Topics

1. Drama
2. Poetry
3. Philosophy
4. Art
5. Fiction

This syllabus was prepared by Brian K. Etter — Last revised on August 10, 2000

LS-489
SENIOR SEMINAR: LEADERSHIP, ETHICS AND CONTEMPORARY ISSUES

DEPARTMENT	Liberal Studies
COORDINATOR	Eugene Hynes, Associate Professor of Liberal Studies
CATALOG DESCRIPTION	This course examines the interrelated subjects of leadership, ethics and contemporary issues. Because it is a culmination of their general education, students in this course use the methods and perspectives learned in the preceding general education courses. After examining general theoretical approaches through a common text, the course will involve three "case studies" with suitable assigned readings. One case study will focus on a corporation in order to illustrate leadership, ethics and contemporary issues; a second will focus on a person in order to illustrate leadership, ethics and contemporary issues; the third will focus on an important modern episode, event or condition that exemplifies issues of ethics and leadership.
PREREQUISITES	COMM-101, Written and Oral Communication I COMM-301, Written and Oral Communication II SSCI-201, Introduction to the Social Sciences HUMN-201, Introduction to the Humanities ECON-201, Principles of Economics One 300 level course in Social Science or in Humanities
CO-REQUISITES	
CLASS/LAB SCHEDULE	Four 60-minute sessions per week or two 120-minute sessions per week. (4-0-4)
TEXTBOOK	Barbara Kellerman (ed.), *Leadership: Multidisciplinary Perspectives*, 1984 Other suitable readings covering the case studies chosen by each teacher.
REFERENCE	M. Neil Browne and Stuart M. Kelley, *Asking the Right Questions: A Guide to Critical Thinking*, 6th ed., 2001
CREDITS	General Education: 4 credits

RELATIONSHIP TO PROGRAM OUTCOMES

LS-489 achieves the following Program Outcomes:

Primary: (d), (f), (g), (h), (i), and (j); *Secondary*:

COURSE LEARNING OBJECTIVES

Each student who receives credit for LS-489 will have demonstrated the ability to do all of the tasks listed below:

1. Students will demonstrate understanding of ethical issues in a contemporary setting.
2. Students will demonstrate understanding of current ethical issues in corporate leadership.
3. Students will demonstrate critical reading, thinking and writing skills.
4. Students will demonstrate understanding of the social contexts of leadership and ethical problems.

TOPICS

1. Disciplinary perspectives on the connections between ethics, leadership and contemporary issues.
2. Three case studies (see course description) chosen by the professor.

This syllabus was prepared by Eugene Hynes — Last revised on August 14, 2000

MATH-101
CALCULUS I

DEPARTMENT	Science and Math
COORDINATOR	Leszek Gawarecki
CATALOG DESCRIPTION	An introduction to the theory and techniques of differentiation of polynomial, trigonometric, exponential, logarithmic, hyperbolic and inverse functions of one variable. Also, included are limits, continuity, derivative applications and interpretations. Computer software will be used to aid in understanding these topics.
PREREQUISITES	
CO-REQUISITES	
CLASS/LAB SCHEDULE	Four 55-minute class periods per week. (4-0-4)
TEXTBOOK	James Steward, *Calculus, Early Transcendentals*, 4th ed.
REFERENCE	
CREDITS	Mathematics: 4 credits

RELATIONSHIP TO PROGRAM OUTCOMES

MATH-101 achieves the following Program Outcomes:

Primary: (a) and (e); *Secondary*:

COURSE LEARNING OBJECTIVES

Each student who receives credit for MATH-101 will have demonstrated the ability to do all of the tasks listed below:

1. Calculate limits involving all basic functions: algebraic, trigonometric, exponential, logarithmic, and their inverses.
2. Calculate derivatives of these basic functions.
3. Use derivatives as an aid in curve sketching.
4. Use derivatives to determine absolute extrema.
5. Use basic modeling techniques to write equations representing a physical system.
6. Use derivatives to solve optimization and related rates problems.
7. Use mathematical software for graphing, determining limits and derivatives.

PREREQUISITES BY TOPICS

1. Polynomial, trigonometric, exponential, logarithmic and inverse functions.
2. Concepts and methods of algebra and elementary analytic geometry.

TOPICS

1. Exponential, logarithmic, hyperbolic functions and inverse functions
2. Limits and continuity
3. Derivatives and their interpretation
4. Differential calculus
5. Applications of differentiation to linear approximation, optimization and modeling with related rates
6. Extreme values and curve sketching
7. Exams

This syllabus was prepared by Leszek Gawarecki Last revised on March 29, 2002

MATH-102
CALCULUS II

DEPARTMENT	Science and Math
COORDINATOR	Katie Jiang, Professor of Mathematics
CATALOG DESCRIPTION	Reimann integration and the Fundamental Theorem of Calculus. Also, applications to area, volume, etc. Basic methods for conversion of integrals including change of variable, substitutions, partial fractions, and integration by parts, improper integrals and numerical integration. Also introduced are sequences and series in one variable with emphasis on Taylor Series.
PREREQUISITES	MATH-101 or MATH-101X, Calculus or permission of Department Head
CO-REQUISITES	
CLASS/LAB SCHEDULE	Four 60-minute class periods per week (4-0-4)
TEXTBOOK	James Steward, Calculus, *Early Transcendentals*, 4th ed., Brooks/Cole Publishing, 1999
REFERENCE	
CREDITS	Mathematics: 4 credits

RELATIONSHIP TO PROGRAM OUTCOMES

MATH-102 achieves the following Program Outcomes:

Primary: (a) and (e); *Secondary*:

COURSE LEARNING OBJECTIVES

Each student who receives credit for MATH-102 will have demonstrated the ability to do all of the tasks listed below:

1. Recognize and apply various integral formulas to find anti-derivatives for use in both definite and indefinite integral situations.
2. Use change of variable substitutions to convert more complicated functional expressions and their integrals into simpler forms so that the direct formulas of #1 may be applied.
3. Know the definition of the Reimann Integral and to acquire a substantial working knowledge of the evaluation and application of definite integrals, including numerical approximations.
4. Have a reasonably good intuitive understanding of the relationship between the definite integral and anti-derivatives as given by the Fundamental Theorem.
5. Be functionally competent in the evaluation of improper integrals.
6. Have a formal understanding of sequences, series and demonstrate a substantial knowledge of computations and related tests for convergence of series and of the algebra and calculus of power series.
7. Evaluate integrals and Numerical Integration using MAPLE.

PREREQUISITES BY TOPICS

1. An intuitive and formal understanding of the limit process and the continuity of functions.
2. An ability to use derivatives in both formal-general and application-specific contexts.
3. An intuitive and formal understanding of the Mean Value and Intermediate Value Theorems.
4. The concept of the inverse function of a continuous one-to-one function, including inverse trigonometric functions.

TOPICS

1. Introduction to the integral. Indefinite integrals, area under a graph, the definite integral, the fundamental theorem of calculus, and numerical integration.
2. Applications of the integral. Area, volume, average value, mean value, theorem.
3. Techniques of integration.
4. Hospital Rule and Improper Integrals.
5. Definition and convergence of a sequence. Tests of convergence of infinite series. Power series, Taylor series and approximate a function by a Taylor Polynomials.

This syllabus was prepared by Katie Jiang — Last revised on May 4, 2000

MATH-203
MULTIVARIATE CALCULUS

DEPARTMENT	Science & Math
COORDINATOR	John Dulin, Associate Professor of Mathematics
CATALOG DESCRIPTION	A study of polar coordinates, parametric equations and the calculus of functions of several variables with an introduction to vector calculus. Topics include surface sketching, partial derivatives, gradients, differentials, multiple integrals, cylindrical and spherical coordinates and applications. Computer software will be used to aid in understanding these concepts.
PREREQUISITES	MATH-102, Calculus II or permission of Department Head
CO-REQUISITES	
CLASS/LAB SCHEDULE	Four 60-minute class periods per week (4-0-4)
TEXTBOOK	James Steward, *Calculus, Early Transcendentals*, 4th ed.
REFERENCE	
CREDITS	Mathematics: 4 credits

RELATIONSHIP TO PROGRAM OUTCOMES

MATH-203 achieves the following Program Outcomes:

Primary: (a) and (e); *Secondary*:

Course Learning Objectives

Each student who receives credit for MATH-203 will have demonstrated the ability to do all of the tasks listed below:

1. Move back and forth between rectangular and polar coordinates in the plane and rectangular, cylindrical and spherical coordinates in space.
2. Sketch 2-dimensional and 3-dimensional figures in each of these coordinate systems.
3. Move back and forth between rectangular and parametric definition of functions, plot and differentiate parametrically represented functions.
4. Evaluate and plot multivariate functions.
5. Take limits and derivatives of multivariate functions.
6. Locate and evaluate unconstrained and constrained optima.
7. Set up and evaluate double and triple integrals in the coordinate systems.
8. Find appropriate areas, volumes, moments and centers of mass.
9. Sketch vector fields and test if conservatives. Find divergence and curl.

Prerequisites by Topics

1. Derivative of functions of one variable.
2. Integration of functions of one variable.
3. Vector algebra and geometry through dot and cross products.
4. Analytic geometry of conic sections.

Topics

1. Polar, cylindrical and spherical coordinates
2. Parametric representations
3. 3-D Geometry, lines
4. Functions of several variables
5. Partial and directional derivatives and surface geometry
6. Optimization
7. Multiple integrals and applications
8. Vector fields
9. Exams, tests, reviews, etc.

This syllabus was prepared by John Dulin — Last revised on May 4, 2000

MATH-204
DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS

DEPARTMENT	Science and Math
COORDINATOR	Katie Jiang, Professor of Mathematics
CATALOG DESCRIPTION	An introduction to the principle and methods for solving first order, first degree differential equations, and higher order linear differential equations. Includes a study of the Laplace transform and its application to the solution of differential equations. Also included is an introduction to Fourier series. Existence and uniqueness theorems for O.D.E's are also discussed.
PREREQUISITES	MATH-203, Multivariate Calculus
CO-REQUISITES	
CLASS/LAB SCHEDULE	Four 60-minute class periods per week (4-0-4)
TEXTBOOK	Dennis G. Zill and Michael R. Cullen, *Differential Equations with Boundary-Value Problems*, 4th ed., ITP, Brooks/Cole, 1997
REFERENCE	
CREDITS	Mathematics: 4 credits

RELATIONSHIP TO PROGRAM OUTCOMES

MATH-204 achieves the following Program Outcomes:

Primary: (a) and (e); *Secondary*:

COURSE LEARNING OBJECTIVES

Each student who receives credit for MATH-204 will have demonstrated the ability to do all of the tasks listed below:

1. Understand the nature of a differential equation and the solution of a differential equation.
2. Solve linear differential equations and common first-order first-degree differential equations encountered in subsequent engineering courses and in engineering practice.
3. Use Laplace transform together with its basic properties as a useful method to solve appropriate differential equations.
4. Use the Fourier series as a tool for frequency analysis.
5. Solve differential equations using MAPLE.

PREREQUISITES BY TOPICS

1. Integral calculus
2. Infinite series

TOPICS

1. Introduction and definition of terms; first-order, first-degree equations
2. Higher-order differential equations
3. Laplace transforms
4. Fourier series
5. Applications

This syllabus was prepared by Katie Jiang Last revised on May 4, 2000

MATH-307
MATRIX ALGEBRA

DEPARTMENT	Science and Math
COORDINATOR	Ilya Kudish, Associate Professor of Mathematics
CATALOG DESCRIPTION	A study of matrix concepts including such topics as basic algebraic operations, determinants, inversion, vector spaces, basis and dimension, solution of systems of linear equations, eigenvalues, and eigenvectors.
PREREQUISITES	MATH-101, Calculus I
CO-REQUISITES	
CLASS/LAB SCHEDULE	Four 60-minute class periods per week (4-0-4)
TEXTBOOK	R. Larson and B. Edwards, *Elementary Linear Algebra*, 4th ed., D.C.Heath & Company, 1999
REFERENCE	
CREDITS	Mathematics: 4 credits

RELATIONSHIP TO PROGRAM OUTCOMES

MATH-307 achieves the following Program Outcomes:

Primary: (a) and (e); *Secondary*:

COURSE LEARNING OBJECTIVES

Each student who receives credit for MATH-307 will have demonstrated the ability to do all of the tasks listed below:

1. Perform basic matrix operations, including scalar multiplication, addition, product, transpose, and inverse
2. Use matrix algebra to represent and solve systems of linear equations and to represent linear transformations
3. Evaluate determinants and use properties of determinants in general algebraic contexts related to products, inverses, etc.
4. Decide whether or not a set of vectors is a vector space
5. Use concepts of basis and dimension in the context of eigenvalue and eigenvector problems

PREREQUISITES BY TOPICS

1. Basic algebraic techniques
2. Functional notation and properties
3. Calculus of functions of one variable

TOPICS

1. Systems of linear equations and related matrix algebra
2. Determinants, applications
3. Vector spaces, subspaces independence, and basis
4. Linear transformations, eigenvalues, and eigenvectors
5. Tests, as required

This syllabus was prepared by Thomas Elsner — Last revised on May 13, 2000

MATH-408
PROBABILITY AND STATISTICS

DEPARTMENT	Science & Math
COORDINATOR	Leszek Gawarecki, Associate Professor of Mathematics
CATALOG DESCRIPTION	A basic understanding of the basic concepts of probability and statistics is provided. Elementary combinatorics, fundamentals of probability, families of discrete and continuous probability distributions, and the Central Limit Theorem are considered. The basic descriptive measures, as well as the basic concepts of estimation and tests of hypotheses are considered. The used of probability and statistics in engineering are illustrated. A brief introduction to MINITAB, a statistical package is given.
PREREQUISITES	MATH-203, Multivariate Calculus
CO-REQUISITES	
CLASS/LAB SCHEDULE	Four 60-minute class periods per week (4-0-4)
TEXTBOOK	R. Sheaffer and James McClave, *Statistics for Business and Economics*, 4th ed.
REFERENCE	
CREDITS	Mathematics: 4 credits

RELATIONSHIP TO PROGRAM OUTCOMES

MATH-408 achieves the following Program Outcomes:

Primary: (a) and (e); *Secondary*:

COURSE LEARNING OBJECTIVES

Each student who receives credit for MATH-408 will have demonstrated the ability to do all of the tasks listed below:

1. Identify specific discrete and continuous probability models and random variables, and calculate related probabilities.
2. Apply specific probability models to practical problems from the area of engineering.
3. Use techniques of descriptive statistics to provide exploratory analysis of data.
4. Calculate and interpret point and interval estimates of selected population parameters.
5. Formulate and test statistical hypotheses for selected parameters of single and multiple populations and interpret the results.
6. Construct and apply control charts for the averages.
7. Formulate and test non-parametric statistical hypotheses involving contingency tables and interpret the results.
8. Use the statistical software MINITAB for descriptive and inferential statistical analysis.

PREREQUISITES BY TOPICS

1. Differential and integral calculus
2. Series

TOPICS

1. Descriptive statistics
2. Introductory probability
3. Random variables, discrete and continuous models
4. Sampling distributions and the Central Limit Theorem
5. Estimation and test of hypotheses for single population
6. Estimation and test of hypotheses for multiple populations
7. Use of MINITAB
8. Test

This syllabus was prepared by Leszek Gawarecki   Last revised on May 2, 2000

MECH-210
MECHANICS I

DEPARTMENT	Mechanical Engineering
COORDINATOR	Richard Stanley and Raghu Echempati
CATALOG DESCRIPTION	This course deals with a discussion and application of the following fundamental concepts: (1) static force analysis of particles, rigid bodies, plane trusses, frames, and machines; (2) first and second moments of area; (3) friction; (4) internal forces; and (5) stress and deflection analyses of axially loaded members. Topics covered will be (1) the static force and moment equilibrium of two and three dimensional systems; (2) resultant forces and moments due to the application of concentrated and/or distributed loads; (3) couples; (4) the center of mass and the area moment of inertia of a rigid body; (5) shear force and bending moment diagrams of a rigid body; and (6) the stress and deflection analyses of axially loaded members. Free body diagrams will be formulated in a computer-aided environment in order to enhance the students' critical thinking and problem solving capabilities. Several open-ended homework and mini projects will be assigned in order to incorporate a design experience in the course.
PREREQUISITES	PHYS-112, Newtonian Mechanics
CO-REQUISITES	MATH-102, Calculus II
CLASS/LAB SCHEDULE	Two 120-minute sessions per week (4-0-4)
TEXTBOOK	W.F. Riley and L.D. Sturges, *Statics*, 2nd ed., John Wiley & Sons
REFERENCE	
CREDITS	Engineering Science: 4 credits

RELATIONSHIP TO PROGRAM OUTCOMES

MECH-210 achieves the following Program Outcomes:

Primary: (l); *Secondary*: (b) and (k)

COURSE LEARNING OBJECTIVES

Each student who receives credit for MECH-210 will have demonstrated the ability to do all of the tasks listed below:

1. Given the drawing or sketch of a physical system, students will be able to draw free body diagrams and determine the resultant or equilibrant forces acting on the simplified physical system.
2. The students will be able to apply the trigonometric rules to various problems concerning the static equilibrium of a system of particles.
3. The students will be able to apply vector methods to various problems concerning the equilibrium of a system of particles.
4. The students will be able to conceptualize concurrent force systems and parallel force systems.

5. The students will be able to understand the principle of transmissibility.
6. The students will be able to use free body diagrams to solve the static equilibrium of system of particles.
7. Given external force vectors acting on a system of rigid bodies, students will be able to determine the resultant forces and moments using vector concepts.
8. Given the type of support and connectivity in a system of rigid bodies in equilibrium (i.e. trusses or frames with pin-joints or rigid supports), students will be able to fully analyze the force system using Newton's laws.
9. Given loads acting on planar linkages and mechanisms (machines), students will be able to determine the internal reactions at the joints.
10. Given loads on a planar system (i.e. a beam), the student will be able to determine reaction forces and moments. The student will then be able to produce shear and moment diagrams using free-body diagram concepts or integration.
11. Given contact conditions and loads, students will be able to understand the concepts of the coefficient of friction and the frictional force.
12. Given a general distributed load, students will be able to determine the equivalent concentrated load and its location using both integration and summation approaches.
13. Students will be able to calculate the center of area (or center of mass) and the area moment of inertia of a system of rigid bodies.
14. Given simple axial loading on a rod, students will be able to calculate linear elastic stresses and strains.

PREREQUISITES BY TOPICS

1. Ordinary derivatives, vector algebra
2. Basic trigonometry (sine and cosine rules)
3. Particle equilibrium
4. Newton's Laws of motion
5. Basics of free body diagrams
6. Basic Computer Skills

TOPICS

1. Introduction, Review of Vector Mechanics, Free Body Diagrams and Trigonometry, Concurrent Force Systems, Applications
2. Rigid Bodies: Moment of a Force, Moment of a Couple, Equivalent Force/Couple Systems, Applications
3. Rigid Body Equilibrium, 2D Systems and 3D Systems, Applications
4. Trusses, Frames and Machines, Method of Joints and Method of Sections
5. Distributed Forces: First Moment of Area, Applications
6. Internal Forces in Structural Members
7. Internal Forces, Shear Force and Bending Moment Diagrams, Applications
8. Friction Concepts Angle of Repose, Maximum Frictional Force, Applications
9. Second Moments of Area, Radius of Gyration, Moments of Inertia, Applications
10. Axially Loaded Members in 2D, Hooke's Law, Stress Analysis of Axially Loaded Members, Applications
11. Deflection Analysis, Applications

This syllabus was prepared by Richard Stanley and Raghu Echempati　　Last revised on July 12, 2000

MFGG-135
INTERDISCIPLINARY DESIGN AND MANUFACTURING

DEPARTMENT	Industrial Manufacturing, Engineering and Business
COORDINATOR	Lucy King, Professor of Manufacturing Engineering
CATALOG DESCRIPTION	This interdisciplinary course introduces principles in manufacturing materials and processes and design methodologies to first year students. These principles are integrated in a hands-on project. This course introduces freshmen to the activities and professional characteristics of each of the engineering disciplines offered by Kettering University.
PREREQUISITES	
CO-REQUISITES	
CLASS/LAB SCHEDULE	One 120-minute lecture session and two 120-minute laboratory sessions per week. (2-4-4)
TEXTBOOK	None
REFERENCE	Notes will be provided by the faculty members teaching the course.
CREDITS	Engineering Science: 3 credits; Engineering Design: 1 credit

RELATIONSHIP TO PROGRAM OUTCOMES

MFGG-135 achieves the following Program Outcomes:

Primary: (d), (h), and (k); *Secondary*: (e) and (l)

COURSE LEARNING OBJECTIVES

Each student who receives credit for MFGG-135 will have demonstrated the ability to do all of the tasks listed below:

1. Explain the functions of different engineering disciplines in the engineering product development cycle.
2. Apply ethics and responsibilities of an engineer to product development cycle.
3. Incorporate fundamental design methodologies and computational tools for the design and analysis of basic mechanical and electrical components.
4. Incorporate basic downstream manufacturing constraints and cost considerations into upstream design process.
5. Develop basic process plans to manufacture the components.
6. Construct a prototype virtual and/or physical model.
7. Function, manage, and communicate effectively as a team member in the project.
8. Effectively communicate through written reports and oral presentations.

TOPICS

1. Discussion of engineering disciplines at Kettering University
2. Ethics and responsibilities of an engineer
3. The design process from concept to manufacture
4. The role of manufacturing processes in a design
5. The interrelationships of design, materials, and manufacturing
6. Prototype build
7. Written and oral presentation of integrated project results

LABORATORY PROJECTS

Manufacturing processes

1. Tensile strength, hardness tests
2. Sheet metal forming
3. Lost foam casting (or green sand casting)
4. Lathe
5. Mill, drill, material removal
6. Welding, material joining
7. Polymer processing

Design Methodology

1. Reverse engineering and creativity
2. Product development cycle/process
3. Design simulation: working model
4. Design simulation: working model (continued)

Electronics

1. Measurement of a speech signal (amplitude, frequency)
2. Measurement of Frequency-Dependent Resistance (impedance)
3. Power requirements of typical electronic systems and devices
4. A Printed Circuit Board Layout

This syllabus was prepared by Lucy King Last revised on February 23, 2001

PHYS-114
NEWTONIAN MECHANICS

DEPARTMENT	Science and Math
COORDINATOR	K. Svinarich, Associate Professor of Applied Physics D. Russell, Associate Professor of Applied Physics
CATALOG DESCRIPTION	A calculus based introduction to classical Newtonian mechanics including vectors, translational and rotational kinematics and dynamics, work, energy, impule, and linear and angular momentum.
PREREQUISITES	MATH-101, Calculus I
CO-REQUISITES	PHYS-115, Newtonian Mechanics Laboratory MATH-102, Calculus II
CLASS/LAB SCHEDULE	Three 60-minute class periods plus one 60-minute recitation period per week. (4-0-3)
TEXTBOOK	Benson, *University Physics*, Revised Edition, John Wiley & Sons, 1996
REFERENCE	
CREDITS	Basic Science: 3 credits

RELATIONSHIP TO PROGRAM OUTCOMES

PHYS-114 achieves the following Program Outcomes:

Primary: (a) and (e); *Secondary*:

COURSE LEARNING OBJECTIVES

Each student who receives credit for PHYS-114 will have demonstrated the ability to do all of the tasks listed below:

1. Define and distinguish between vector and scalar quantities, distance and displacement, speed and velocity, linear and acceleration, mass and weight, force, static and kinetic friction, kinetic and potential energy, work and power, momentum and impulse, conservative and nonconservative forces, acceleration and gravitational field strength, torque and rotational inertia, angular displacement, angular velocity, angular acceleration, angular momentum, center of mass.
2. Apply the laws of classical physics (Kinematic equations, Newton's laws of motion, work-energy theorem, conservation of energy, conservation of momentum, impulse) to problems involving particles and solid bodies rotating about a fixed axis.
3. Given two vectors, add and subtract them using graphical methods and component forms, and compute scalar and vector products.
4. Given a plot of one of x(t), v(t), or a(t), use the slope and area under the curve to obtain the remaining plots.
5. Draw a free body diagram of an object that treated as a point mass or an object rotating about a fixed axis.
6. Determine the moment of inertia and the center of mass of a system of point masses, and for a simple continuous mass.

PREREQUISITES BY TOPIC

1. Ability to correctly use algebra, vectors, and trigonometry
2. Understanding of the meaning of a derivative and integral
3. Ability to differentiate and integrate standard algebraic forms

TOPICS

1. Vectors (components, addition and subtraction, vector and scalar products)
2. Graphing of x(t), v(t), and a(t)
3. 1-D and 1-D motion of particles
4. Newton's laws of motion and Free-body diagrams
5. Work and the Conservation of Energy
6. Momentum and Collisions
7. Rotational kinematics and dynamics
8. Angular momentum
9. Gravity
10. Problem solving sessions
11. Exams

This syllabus was prepared by Dan Russell — Last revised on January 10, 2002

PHYS-115
NEWTONIAN MECHANICS LABORATORY

DEPARTMENT	Science and Math
COORDINATOR	K. Svinarich, Associate Professor of Applied Physics B. Roughani, Associate Professor of Applied Physics
CATALOG DESCRIPTION	Laboratory topics include: curve fitting and graphing, static equilibrium and vector addition, uniformly accelerated motion in two dimensions, Newton's second law, circular motion, work and energy, collisions, moment of inertia, and equilibrium of a rigid body.
PREREQUISITES	MATH-101, Calculus I
CO-REQUISITES	PHYS-114, Newtonian Mechanics MATH-102, Calculus II
CLASS/LAB SCHEDULE	One 120-minute laboratory session per week. (0-2-1)
TEXTBOOK	In-house PHYS-115 Laboratory Manual
REFERENCE	
CREDITS	Basic Science: 1 credit

RELATIONSHIP TO PROGRAM OUTCOMES

PHYS-115 achieves the following Program Outcomes:

Primary: (a) and (e); *Secondary*:

COURSE LEARNING OBJECTIVES

Each student who receives credit for PHYS-115 will have demonstrated the ability to do all of the tasks listed below:

1. Rearrange a mathematical expression to obtain a straight line graph.
2. Create a hand-drawn graph.
3. Obtain and interpret the physical meaning of the slope, intercept, and area under a curve.
4. Determine the instrument error in a measurement.
5. Demonstrate knowledge/understanding of the physical concepts of: force, energy, and work. Successful students must be able to distinguish between these concepts.

PREREQUISITES BY TOPICS

1. Ability to make a simple measurement using a balance and a ruler
2. Ability to take a derivative
3. Ability to perform simple algebraic manipulations

LABORATORY PROJECTS

1. Curve fitting and graphing
2. Static equilibrium and vector addition
3. Uniformly accelerated rectilinear motion
4. Uniformly accelerated motion in two dimensions
5. Newton's second law
6. Circular motion
7. Work and energy
8. Collisions
9. Moment of inertia
10. Ballistic Pendulum
11. Equilibrium of a solid body

This syllabus was prepared by Dan Russell Last revised on March 30, 2001

PHYS-224
ELECTRICITY & MAGNETISM

DEPARTMENT	Science and Math
COORDINATOR	K. Svinarich, Associate Professor of Applied Physics G. Hassold, Associate Professor of Applied Physics
CATALOG DESCRIPTION	An investigation of the physics of electricity and magnetism with a focus on the physics of electric and magnetic fields and their effects on electric charges. Topics will include the relationships between charges, forces, fields, potentials, and currents, as well as the physics of capacitors, resistors, and inductors. This course includes one hour of recitation in addition to three hours of class.
PREREQUISITES	PHYS-114, Newtonian Mechanics PHYS-115, Newtonian Mechanics Laboratory MATH-102, Calculus II
CO-REQUISITES	PHYS-225, Electricity & Magnetism Laboratory MATH-203, Multivariate Calculus
CLASS/LAB SCHEDULE	Three 60-minute lectures and one 60-minute recitation per week. (4-0-3)
TEXTBOOK	Benson, *University Physics*, Revised Edition, John Wiley & Sons, 1996
REFERENCE	
CREDITS	Basic Science: 3 credits

RELATIONSHIP TO PROGRAM OUTCOMES

PHYS-224 achieves the following Program Outcomes:

Primary: (a) and (e); *Secondary*:

COURSE LEARNING OBJECTIVES

Each student who receives credit for PHYS-224 will have demonstrated the ability to do all of the tasks listed below:

1. Define and distinguish between conductors and insulators, current and voltage, electric field strength, electric potential and potential energy, magnetic fields strength, electric and magnetic dipoles, capacitance, resistance, inductance.
2. Find the resultant vector force on a point charge due to other point charges in a two-dimensional plane.
3. Find the resultant electric field strength and electric potential due to a collection of point charges.
4. Determine the resulting torque on an electric dipole in an electric field.
5. Given the electric potential at a point find the potential energy of a charge placed at the point.
6. Using integration derive the expression for the electric field strength and electric potential due to continuous non-conducting lines, rings, and arcs of charge.
7. Use Gauss's law to determine the expression for the electric field due to continuous non-conducting and conducting charge distributions.
8. Use the gradient to determine the electric field strength from the electric potential, and use integration to determine the electric potential from the electric field strength.
9. Determine the equivalent capacitance or resistance of series and parallel combinations of capacitors and resistors.
10. Find the force on a moving charge, force on a current carrying wire, and torque on a current loop in a magnetic field.
11. Find the resultant force on a long straight current carrying wire due to other parallel current carrying wires.
12. Use Ampere's law to determine the expression for the magnetic field due to current carried by long straight wires, solenoids, and toroids.
13. Use Faraday's Law to determine the emf induced in loops of conducting wire, and Lenz's Law to determine the direction of the induced emfs.
14. Solve problems involving self and mutual inductance.

PREREQUISITES BY TOPICS

1. Basic mathematical skills: algebra, trigonometry, geometry
2. Vector addition, dot and cross product
3. Differentiation and integration of polynomials and simple transcendental functions
4. Mechanics of linear and circular motion; Newton's laws, conservation of energy
5. Ability to use calculators and computers for analysis, graphing, and problem solving

TOPICS

1. Electric charges and electric fields
2. Electric flux and Gauss's Law for electricity
3. Electric potential and potential energy
4. Capacitance and resistance
5. Electric current and magnetic fields
6. Faraday's Law and inductors
7. Problem solving sessions
8. Exams

This syllabus was prepared by Dan Russell — Last revised on March 30, 2001

PHYS-225
ELECTRICITY & MAGNETISM LABORATORY

DEPARTMENT	Science and Math
COORDINATOR	K. Svinarich, Associate Professor of Applies Physics G. Hassold, Associate Professor of Applied Physics
CATALOG DESCRIPTION	This laboratory investigates the physics of electricity and magnetism. It includes a practical study of electric potential and electric current, as well as the fundamental circuit elements: capacitors, resistors, and inductors.
PREREQUISITES	PHYS-114, Newtonian Mechanics PHYS-115, Newtonian Mechanics Laboratory MATH-102, Calculus II
CO-REQUISITES	PHYS-224, Electricity & Magnetism MATH-203, Multivariate Calculus
CLASS/LAB SCHEDULE	One 120-minute laboratory session per week. (0-2-1)
TEXTBOOK	In-house PHYS-225 Laboratory Manual
REFERENCE	
CREDITS	Basic Science: 1 credit

RELATIONSHIP TO PROGRAM OUTCOMES

PHYS-225 achieves the following Program Outcomes:

Primary: (a) and (e); *Secondary*:

Course Learning Objectives

Each student who receives credit for PHYS-225 will have demonstrated the ability to do all of the tasks listed below:

1. Perform basic error analysis/propagation
2. Properly make the following electrical measurements: resistance, capacitance, voltage and current.
3. Properly use: digital multimeters, power supplies, and oscilloscopes.
4. Distinguish the difference between power and energy, and between potential and potential energy.

Prerequisites by Topics

1. Ability to rearrange a mathematical expression to obtain a straight-line graph.
2. Ability to create a hand-drawn graph.
3. Ability to obtain and interpret the physical meaning of the slop, intercept and area under a curve.
4. Ability to determine the instrument error in a measurement.

Laboratory Projects

1. Error analysis
2. Instrumentation
3. Coulomb's Law
4. Electric field and electric potential
5. Capacitance
6. Ohm's law, resistors in series and parallel
7. Electron e/m ratio
8. Current balance
9. Faraday's Law

This syllabus was prepared by Dan Russell   Last revised on March 30, 2001

SSCI-201
INTRODUCTION TO THE SOCIAL SCIENCES

DEPARTMENT	Liberal Studies
COORDINATOR	Eugene Hynes, Associate Professor of Liberal Studies
CATALOG DESCRIPTION	This course will offer a broad comparative study of the nature of human experience, how social scientists study that experience, and some of their findings. It will consider moral and ethical issues (in society and in studying society). It will examine selected topics for what they teach us about society in general, our present society, or social science. The topics selected will vary from term to term but will include contemporary issues within such areas as science and technology, religion, politics, the environment, and human conflict.
PREREQUISITES	COMM-101, Written and Oral Communication I
CO-REQUISITES	
CLASS/LAB SCHEDULE	Four 60-minute sessions per week or two 120-minute sessions per week. (4-0-4)
TEXTBOOK(S)	Elgin F. Hung and David C. Colander, Social Science: *An Introduction to the Study of Society*, 10th ed., 1999 Allan G. Johnson, *The Forest and the Trees: Sociology as Life, Practice and Promise*, 1997 Thomas A. Easton, ed., *Taking Sides: Clashing Views on Controversial Issues in Science, Technology, and Society*, 2000 One or more monographs, such as: Alfred Crosby, *The Columbian Exchange: Biological and Cultural Consequences of 1492*, 1972 or Sidney Mintz, *Sweetness and Power: The Place of Sugar in Modern History*, 1986 or Daniel R. Headrick, *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century*, 1981 or Ronald Hyam, *Empire and Sexuality: The British Experience*, 1992
REFERENCE	A book on critical thinking, such as: M. Neil Browne and Stuart M. Keeley, *Asking the Right Questions: A Guide to Critical Thinking*, 5th ed., 1998
CREDITS	General Education: 4 credits

RELATIONSHIP TO PROGRAM OUTCOMES

SSCI-201 achieves the following Program Outcomes:

Primary: (d), (g) and (j); *Secondary*:

COURSE LEARNING OBJECTIVES

Each student who receives credit for SSCI-201 will have demonstrated the ability to do all of the tasks listed below:

1. To have students demonstrate an understanding of the social sciences
2. To have students demonstrate an understanding of their larger global and societal context
3. To have students demonstrate a knowledge of contemporary issues
4. To have student demonstrate an understanding of human nature, including its moral and ethical dimensions
5. To have students demonstrate critical reading, thinking, and writing skills

TOPICS

1. Social Science and Society: Concepts and Methods
2. Human Origins: Western Civilization
3. Society and Culture
4. Demography and Ecology
5. The Individual and the Family
6. Technology and Society
7. Religions of the World
8. Social and Economic Differentiation
9. Economic Systems and Economic Development
10. International Relations and World Conflict

This syllabus was prepared by Eugene Hynes Last revised on August 12, 2000

C. Faculty Resumes

Resume
Electrical & Computer Engineering

1. **Name**: Michael E. Elta **Birth Date**: 01/01/1951

2. **Academic Rank**: Visiting Professor of Electrical Engineering

3. **Degrees**:

PhD	Electrical Engineering	University of Michigan	1978
MS	Electrical Engineering	University of Michigan	1975
BSE	Electrical Engineering	General Motors Institute	1975

4. **Years on this Faculty**: Two

5. **Other Related Experience**:

Teaching and Research

Washtenaw Community College, Internet Professional Program: Web Design and Graphical Design, Motorcycle Safety Classes, Continuing Education, 2000-2002

The University of Michigan: Research Scientist, 1995-1999; Executive Director, Center for Display Manufacturing, 1993-1996; Manager, Solid-State Electronics Laboratory, 1986-1992; Assistant Professor, 1982-1986; Graduate Student Research Assistant, 1975-1982.

Industrial

National Center for Manufacturing Science, Program Manager, 1998-1999

MIT Lincoln Laboratory, Staff Scientist, 1978-1982

Other

Thesis Supervision (2 Masters and 12 PhD thesis students); Member of 8 PhD Committees – The University of Michigan, 1984-1996

Directed program, developed course material, and taught classes for the training of factory workers in high-tech electronics companies. Course modules included photoresist processing, thin film deposition, furnace processing, testing, quality, and statistics. 1993-1996

Development of State of Michigan program for the education of high-tech factory workers with Oakland, Ford, and Washtenaw Community colleges.

6. **Consulting**:

PicoMetrix Inc., 2000-2001

Expert Witness Cases (Control and Sensors for Semiconductor Equipment), 1990-2001

7. **Professional Registration**:

8. **Publications**:

Rashap, B.A., Elta, M.E., Etemad, H., Fournier, J.P., Freudenberg, J.S., Giles, M.D., Grizzle, J.W., Kabamba, P.T., Khargonekar, P.P., Lafortune, S., Meerkow, S.M., Moyne, J.R., Tenekeetzis, D., and Terry, Jr., F.L., **Control of Semiconductor Manufacturing Equipment: Reactive Ion Etching**, *IEEE Transactions on Semiconductor Manufacturing*, Vol. 8, No.3, pp. 286-297, August 1995.

Elta, M.E., Freudenberg, J.S., Grizzle, J.W., Khargonekar, P.P., and Terry, Jr., F.L**., Improving RIE Process Robustness via Real-Time Feedback Control**, *Electrochemistry Society Meeting, Reno*, Nevada, May 1995.

Moyne, J., Etemad, H., and Elta, M.E., **A Run-to-Run Control Framework for VLSI Manufacturing**, *Proc. SPIE Conference, Microelectronics Processing*, September 1993.

Morris, T., Grimard, D., Shu, C., Terry, Jr., F.L., Elta, M.E., and Jain, R., **Utilizing Diffraction Imaging For Non-Destructive Wafer Topography Measurements**, *SPIE 1992 Symposium on Microlithography*, San Jose, California, March 1993.

Elta, M.E., **Developing 'Smart' Controllers for Semiconductor Processes**, *R&D Magazine,* pp. 66-70, February 1993.

Pender, J., Buie, M., Vincent, T., Holloway, J., Elta, M.E., and Brake, M., **Radial Optical Emmission Profiles of Radio Frequency Glow Discharges,** *Journal of Applied Physics* 75(5), pp. 3590-3593, September 1993.

Passow, M.L., Pender, J., Brake, M.L., Sung K.T., Liu, Y., Pang, S.W., and Elta, M.E**., Relative Flourine Concentration in RF and ECR Microwave/RF Hybrid Glow Discharges**, *Applied Physics Letters*, Vol. 60, No.7, February 1992.

Elta, M.E**., Process and Equipment Modeling for Manufacturing**, *SRC/DARPA Workshop on Computer Aided Semiconductor Manufacturing*, NCSU, August 1991.

Elta, M.E., **Process and Equipment Control for Semiconductor Manufacturing Using Plasma Etching As a Process Vehicle***, SRC Workshop on Real-Time Tool Controllers 1991*, Vancover, B.C., February 1991.

Colter, T.J., and Elta, M.E., **Plasma Etch Technology in Microelectronics Manufacturing**, *IEEE Circuits and Devices Magazine*, Vol. 6, No. 4, pp. 38-43, July 1990.

Elta, M.E., **Automated Semiconductor Process Equipment Control in 1994: A Look Ahead**, *SRC/DARPA Workshop on Computer-Aided Semiconductor Manufacturing*, Stanford University, August 1988.

9. **Scientific and Professional Society Memberships**:
   Institute of Electrical and Electronic Engineers (IEEE)
   American Vacuum Society
   Semiconductor Safety Association

10. **Honors and Awards**:
    Tau Beta Pi
    Sigma Xi
    College of Engineering Research Scientist of the Year, 1996
    Rackham Pre-doctoral Fellowship, 1977-1978
    Kodak Fellowship, 1975
    General Motors Fellowship, 1973-1975

11. **Institutional and Professional Service**:

12. **Professional Development**:

Resume
Electrical & Computer Engineering

1. **Name**: Cynthia J. Finelli **Birth Date**: 02/12/65

2. **Academic Rank**: Associate Professor of Electrical Engineering

3. **Degrees**:

PhD	Electrical Engineering: Systems	University of Michigan, Ann Arbor	1993
MSE	Electrical Engineering: Systems	University of Michigan, Ann Arbor	1989
BSE	Electrical Engineering	University of Michigan, Ann Arbor	1988

4. **Years on this Faculty**: Eleven

Director of Center for Excellence in Teaching & Learning	2001
Associate Professor of Electrical Engineering	1996
Assistant Professor of Electrical Engineering	1993
Instructor of Electrical Engineering	1992

5. **Other Related Experience**:
Teaching
Teaching Assistant, University of Michigan, 1988
Industrial
Electrical Engineering Co-op Student, Saginaw Division of General Motors, 1985-1987
Research
Research Assistant, University of Michigan, 1985-1992

6. **Consulting**:
Expert Witness: Weisman vs Omron Healthcare, Inc. Testified regarding Omron Model 145 blood pressure monitor and the signal processing algorithm utilized in determining blood pressure 1998-1999

7. **Professional Registration**:

8. **Publications**:

Finelli, C.J., Harding, T.S., Carpenter, D.D., and Passow, H.J, **How Possible Consequences Affect A Student's Decision to Cheat or Not**, accepted for presented at the *2003 Annual Conference of the American Society for Engineering Education*, Nashville, Tennessee, June 22-25, 2003

Finelli, C.J., **Learning and Teaching Styles**, presented at University of Michigan College of Engineering, December 5, 2002

Coward, P., Zakrajsek, T., and Finelli, C.J., **Out of Thin Air: Building a Teaching Development Center**, *27th Annual Conference of the Professional and Organizational Development in Higher Education Network*, Atlanta, Georgia, October 12, 2002

Finelli, C.J. and Yokomoto, C.F., **Do Students Who Know More Solve Problems More Successfully?** *2002 Annual Conference of the American Society for Engineering Education*, Montreal, Quebec, Canada, June 16-19, 2002 (Available on CD-Rom)

Harding, T.S. and Finelli, C.J., **Suggestions for Establishing Centers for Engineering Education**, *2002 Annual Conference of the American Society for Engineering Education*, Montreal, Quebec, Canada, June 16-19, 2002 (Available on CD-Rom)

Finelli, C.J., Klinger, A., and Budny, D.D., **Strategies for Improving the Classroom Environment**, *Journal of Engineering Education*, 90(4), pp. 491-498, October 2001 (Invited Manuscript)

Finelli, C.J., **Assessing Improvement in Students' Team Skills and Using a Learning Style Inventory to Increase It**, *31st Annual IEEE/ASEE Frontiers in Education Conference*, Reno Nevada, October 10-13, 2001 (Available on CE-Rom)

Ohland, M.W. and Finelli, C.J., **Peer Evaluation in a Mandatory Cooperative Education Environment**, *2001 Annual Conference of the American Society for Engineering Education*, Albuquerque, New Mexico, June 24-27, 2001 (Available on CE-Rom)

Winkler, B.S., Finelli, C.J., Doty, S.L., Svinarich K.A., and Crawford, K., **Support of Retinal Function by Lactate: Dependence on Aspartate Aminotransaminase**, *Annual Society For Neuroscience Conference*, New Orleans, Louisiana, November 8, 2000

Klinger, A., Finelli, C.J., and Budny, D.D., **Improving the Classroom Environment**, *30th Annual IEEE/ASEE Frontiers in Education Conference*, Kansas City, Missouri, October 18-21, 2000, (Available on CE-Rom)

Wilkinson, K.R., Finellil, C.J., Hynes, E., and Alzahabi, B., **University-Wide Curriculum Reform: Two Processes to Aid in Decision Making**, **30th Annual IEEE/ASEE Frontiers in Education Conference**, Kansas City, Missouri, October 18-21, 2000 (Available on CD-Rom)

Finelli, C.J., **Promoting Active Learning Using Cooperative Learning Techniques**, *2000 North East Regional ASEE Annual Conference*, Lowell, Massachusetts, April 28, 2000. (Invited Lecture)

Finelli, C.J. and Wicks, M.A., **An Instrument for Assessing the Effectiveness of the Circuits Curriculum in an Electrical Engineering Program***, IEEE Transactions on Education,* 43(2), pp. 137-142, May 2000

9. **Scientific and Professional Society Memberships**:

Professional and Organizational Development in Higher Education Network
American Society for Engineering Education
IEEE Engineering in Medicine & Biology Society
Institute of Electrical and Electronic Engineers
IEEE Education Society, Tau Beta Pi, Eta Kappa Nu

10. **Honors and Awards**:

Richard L. Terrell Professor for Excellence in Teaching Award, December 2002
Kettering University Outstanding Chapter Advisor of the Year, March 1998
GMI Alumni Association Outstanding Teacher of the Year, 1997

Ohland, M.W., Bullard, L., Finelli, C.J., Layton, R.A., Loughry, M., National Science Foundation - Assessment of Student Achievement in Undergraduate Education*, Designing a Peer Evaluation Instrument that is Simple, Reliable, and Valid*, Proposal #0243254 for $459,877
Proposal Awarded June 2003

Nasr, K.J., Finelli, C.J., Harding, T.S., and Wilkinson, K., National Science Foundation – Assessment of Student Achievement in Undergraduate Education, *Assessing the Contribution of Cooperative Work Experience in Engineering Education*, Proposal #0243247 for $393,532
Proposal Submitted September 4, 2002

Harding, T.S., Carpenter, D.D., and Finelli, C.J., Educational Research and Methods Minigrant Program, *A Comparison of Factors that Influence Cheating in Engineering Undergraduates*
$2500 Grant Awarded October 2002

11. **Institutional and Professional Service**:

Department Committees
ECE Curriculum Committee
Course Coordinator
EE-230, Signals & Systems
Institute Committees
Center for Excellence in Teaching and Learning Advisory Board Chairperson
Faculty Senate Committee on Thesis Learning Objectives
Faculty Development Strategic Planning Committee
Kettering Educators Encouraging Persistence, Executive Committee
Kettering University Alumni Association Rhodes Professorship Selection Committee

12. **Professional Development**:

Program Co-Chair for 32nd Annual IEEE/ASEE Frontiers in Education Conference, November 2003

Reviewer for: National Science Foundation, Proceedings of the IEEE, Journal of Engineering Education, IEEE Transactions on Education, and Educational Research and Methods Division

Resume
Electrical & Computer Engineering

1. **Name**: James E. Gover **Birth Date**: 12/30/1940

2. **Academic Rank**: Professor of Electrical Engineering

3. **Degrees**:

PhD	Nuclear Engineering	University of New Mexico	1971
MS	Electrical Engineering	University of New Mexico	1965
BS	Electrical Engineering	University of Kentucky	1963

4. **Years on this Faculty**: Four
Department Head 8/1998 – 12/31/2001

5. **Other Related Experience**:

Policy Development

Sandia National Laboratories, New Mexico, Senior Scientist, Executive Staff: developed research park strategy for regional economic development; determined how Congress can increase public return from federal R&D; researched major public problems of 21st century, 1995-1998

IEEE Executive Fellow: U.S. DOC, Technology Administration: modeled commercialization; developed models of manufacturing extension and consortia, 1993-1994

IEEE Competitiveness Fellow: Office of Senator Roth: Co-developed $5 billion bill on competitiveness; researched health care and reinventing government issues, 1991-1992

IEEE Congressional Fellow: Office of Senator Domenici & U.S. House of Representatives Science Committee; principal researcher and writer for study of U.S. technology competitiveness, 1988

Research and Development

Sandia National Laboratories, New Mexico, Silicon Programs Development: developed new microelectronics technology transfer program, 1989-1990

SNL, Radiation Effects in Microelectronics: researched radiation hardness of the W-88 warhead microelectronics; modeled radiation-induced latch-up and upset in CMOS-ICs and neutron hard-error generation in MNOS memories; developed university-based research programs, 1983-1987

SNL, Energy Subsystems: developed heavy oil extraction control system, power conditioning for photovoltaics, radiation-hardened instrumentation for nuclear power plants and breeder fuel reprocessing robotics, 1978-1982

SNL, Pulsed Power Technology: developed and modeled explosively-driven ferroelectric transducers and compressed magnetic field generators, 1976-1977

SNL, Firing Systems Development: developed and coordinated production of Spartan and Sprint Anti-Ballistic Missile (ABM) nuclear warheads' firing systems at Allied Signal Corporation, 1974-1975

SNL, Radiation Effects in Electronics: conducted underground nuclear effects research on electronic, explosive, and electromechanical weapons components, 1971-1973

SNL, Member, Engineering Staff: conducted underground nuclear effects research on explosive components and modeled radiation-induced thermomechanical shock and internal EMP, 1963-1970

Continuing Education

Electrification of the Automobile: 12 Volts to 42 Volts to Fuel Cells, Delphi World Wide Web, November 2002

Nuclear Radiation Effects in Microelectronics, developed and taught at SNL, AT&T, US Army, US NRC, US Navy SSPO, 2 American Nuclear Society Conferences, and 3 IEEE Nuclear and Space Radiation Effects Conferences

Applied Nuclear Physics, developed and taught at Sandia National Laboratories

High Intensity Magnetic Fields, developed and taught at Sandia National Laboratories

6. **Consulting**:
General Motors Corporation: EMC Modeling of Wiring Harness Connectors, 2002
Sandia National Laboratories: Modeling of Noise Generation in Pulsed Power Circuits, 2002-2003

7. **Professional Registration**:

8. **Publications**:
Gover, James E., and Huray, Paul G., **When Nuclear Weapons are the Weapons of Choice**, *IEEE Spectrum*, March 2003, pp. 15-16.
Gover, James E**., Circumventing the Challenges of Fuel Cell Powered Automobiles**, *Proceedings of the ASME 1st International Conference – Fuel Cell Science, Engineering and Technology*, April 21-23, 2003, Rochester, New York.
Ubong, Etim U., Gover, James E., and Patterson, Dean, **Steps Required for Practical Stationary and Mobile Fuel Cell Applications**, *Proceedings of 2002 EMCWA Conference*, Co-sponsored by IEEE Dielectrics and Electrical Insulation Society, October 2002, pp. 133-140.
Gover, James E., Ubong, Etim U., and Patterson, Dean, **Convergence of Commercial Electric Power Automotive Electric Power to a Common Platform**, *Proceedings of 2002 IEEE EMCWA Conference*, October 2002, Co-sponsored by IEEE Dielectrics and Electrical Insulation Society, October 2002, pp. 127-132.
Gover, James E., Ubong, Etim U., and Patterson, Dean, **Challenges Beyond the Fuel Cell in the Fuel Cell Economy***, Proceedings of 2002 IEEE EMCWA Conference*, October 2002, pp. 141-145.
Gover, James E., and Huray, Paul G., **An Engineering Model for Managing Counter-Terrorism**, *Proceedings of IEEE International Conference on Engineering Management*, Cambridge, England, August 2002.

9. **Scientific and Professional Memberships**:
Institute of Electrical and Electronic Engineers (IEEE)
Tau Beta Pi
Eta Kappa Nu

10. **Honors and Awards**:
IEEE-USA Citation of Honor, 1998
IEEE-USA Executive Fellow, 1994-1995 (US Department of Commerce)
IEEE-USA Competitiveness Fellow, 1992-1993 (Office of Senator Roth)
IEEE-USA Congressional Fellow, 1988 (Office of Senator Domenici)
IEEE-USA Fellow, 1987

11. **Institutional and Professional Service**:
ECE Department Strategic Planning Committee
Kettering University Strategic Planning Committee on University Partnerships
ECE Department Graduate Education Committee

12. **Professional Development**:
Maxwell Equation Solvers Workshop, Ansoft Corporation, 2002
IEEE EMCT Electromagnetic Compatibility Tutorial Review

Resume
Electrical & Computer Engineering

1. **Name**: Bhag S. Guru **Birth Date**: 01/15/1945

2. **Academic Rank**: Professor of Electrical Engineering

3. **Degrees**:

PhD	Electrical Engineering	Michigan State University	1976
MS	Electrical Engineering	Michigan State University	1972
BS	Electronics and Electrical Communication	Punjab University, Chandigarh, India	1968

4. **Years on this Faculty**: Eighteen
Professor of Electrical Engineering 1989
Associate Professor of Electrical Engineering 1984

5. **Other Related Experience**:
Teaching
Lansing Community College, Instructor: basic electrical theory, DC motors and generators, AC motors and alternators, and transformer technology, 1980
Mott Community College, Instructor: basic college algebra, 1978-1980
Michigan State University, Graduate Teaching Assistant, Electrical Engineering Department: Assistant in Junior level EM theory; Instructor in EM fields, radiations and plasmas, 1972-1973
Industrial
Universal Electric Company, Owosso, Michigan: Manager of Research and Electrical Design Department, 1976-1982
Continuing Education
Electrical Machinery: Applications and Control, GMI Engineering & Management Institute, Flint, Michigan, March 1989
Power Electronics: Delco Electronics, Kokomo, Indiana

6. **Consulting**
Universal Electric Company
RMR Motor Corporation
Rexair Corporation
Ford Motor Company
Greenmont Veterinary Hospital: Developed veterinary computer program using Clipper.

7. **Professional Registration**:

8. **Publications**:
Guru, B.S., and Hiziroglu, H.R., **Electromagnetic Field Theory Fundamentals**, published by PWS, International Thomson Publishing Company, First Edition, 1998, Second Edition is in production by Cambridge University Press.
Guru, B.S., and Hiziroglu, H.R., **Electric Machinery and Transformers**, published by Oxford University Press, First Edition, 1988, Second Edition, 1995, Third Edition 2001.

9. **Scientific and Professional Society Memberships**:
Eta Kappa Nu

10. **Honors and Awards**:

Co-investigator, National Science Foundation Grant No. USE-8851806, $100,000 for development of new high-voltage laboratory, 1988-1990. Principal Investigator: H. Hiziroglu

Principal Investigator, National Science Foundation Grant No. CSI-8750931, $50,000 for improvement of undergraduate electrical machines laboratory, 1987-1988. Co-investigator: H. Hiziroglu

11. **Institutional and Professional Service**:

Course Coordinator

ECE-442, Electrical Machines
ECE-443, Electrical Machines Lab
ECE-442, Power Electronics & Applications

Institute Committees

Assessment Committee

Department Committees

EE Curriculum Committee
EE Faculty Search Committee
Promotion Committee

12. **Professional Development**

Workshop Attended

NSF/ONR Sponsored Faculty Workshop, Power Electronics and Electric Drives, January 2003, Arizona State University, Tempe, Arizona

Resume
Electrical & Computer Engineering

1. **Name**: Kenneth L. Kaiser **Birth Date**: 07/19/61

2. **Academic Rank**: Associate Professor of Electrical Engineering

3. **Degrees**:

PhD	Electrical Engineering	Purdue University	1989
MS	Electrical Engineering	Purdue University	1984
BS	Electrical Engineering	Purdue University	1983

4. **Years on this Faculty**: Thirteen
Associate Professor of Electrical Engineering 1994
Assistant Professor of Electrical Engineering 1990

5. **Other Related Experience**:
Teaching
Purdue University, Course Instructor, 1984, 1989
Purdue University, Laboratory Instructor, 1983 – 1987
Purdue University, Teaching Assistant, 1983 – 1984
Industrial
Terronics Development Corporation, Development Engineering, 1990
US Government, Project Engineer, 1985 – 1987
Bell Laboratories, Circuit Designer, 1980
Other
Purdue University, Research Assistant, 1987 – 1989
Developed Electromagnetic Compatibility Course for Delco Electronics, 1995
EIT Review Course Instruction, 1994 **-** present

6. **Consulting**:
Brooks & Kushman, P.C., Southfield, Michigan
TeleCommunication Engineers, Inc., Lennon, Michigan
Hinterman Electric Company, Flint, Michigan
Terronics Development Corporation, Elwood, Indiana, 1989 – Present
Beta Tech, Inc., Roseville, Michigan
Sarnes, 3M Health Care, Ann Arbor, Michigan

7. **Professional Registration**:
Certified Engineer-in-Training, August, 1983
Amateur Extra Class License
First Class Commercial Radiotelephone with Radar Endorsement

8. **Publications**:
Kaiser, K. L., **Electromagnetic Compatibility: A Handbook for Students, Engineers, and Consultants** (Textbook in Progress)
Kaiser, Kenneth L., and McDonald, J., **A Professor's First Internet Course: A Detailed Journal**, *Computers in Education Journal*, March 1, 1999
Kaiser, K.L**., Non-Contact Bicycle Electrical Generator Feasibility Study**, contracted by Brooks & Kushman, 1998
Kaiser, K.L., **Test Requirements: Test Procedure Overview, Data Interpretation and Reliability Improvement Suggestions**, contracted by Delco Electronics, July 1995
Kaiser, M.J., Kaiser, K.L., and Weeks, W.L., **Critical Charge Relationship for Spherical Droplets of Perfect and Imperfect Insulative Liquids**, *Mechanics Research Communications*, Vol. 21, No. 1., 1994

Kaiser, M.J., Kaiser, K.L. and Weeks, W.L., **Surface Charge Representations and a Finite Difference Method for Approximating the Charge Flow Equation**, *Applied Mathematical Modeling*, Vol. 18, April 1994

9. **Scientific and Professional Society Memberships**:
Institute of Electrical and Electronics Engineers (IEEE)
Electrostatics Society of America (ESA)
Eta Kappa Nu Association

10. **Honors and Awards**:
GMI Alumni Outstanding Teaching Award, 1994
Magood Award for Teaching Excellence, April 1987
Selected as David Ross Summer Grant Recipient, 1986
Eta Kappa Nu

11. **Institutional and Professional Service**:
Course Coordinator
ECE-340, Electromagnetics I
ECE-544, Electromagnetic Compatibility
ECE-401, Capstone Design Project
Department Committees
EE Search Committee Chairperson, 2002-2003
Leader of Department Chairperson Evaluation, 1999
Department Head Search Committee, 1997
Student Focus Group Committee, 1998
Graduate Curriculum Committee, 1995-1998
Institute Committees
Curriculum Subcommittee
Total Quality Management Study Group
Academic Programs and Policies Committee
Recreation Center Advisory Committee
Faculty Advisor
Delta Tau Delta Fraternity
IEEE Student Chapter

12. **Professional Development**:
Madonna Assessment Conference, 1996
IEEE, IAS Conference, Toronto, Ontario, Canada, 1993

Resume
Electrical & Computer Engineering

1. **Name**: David J. Leffen **Birth Date**: 07/02/1944

2. **Academic Rank**: Professor of Electrical Engineering

3. **Degrees**:

PhD	Electrical Engineering	University of Waterloo, Canada	1973
MSc	Electrical Engineering	University of New Brunswick, Canada	1969
BASc	Electrical Engineering	University of Waterloo, Canada	1967

4. **Years on this Faculty**: Fifteen

Professor of Electrical Engineering	1999
Department Head	1992
Professor of Electrical Engineering	1988

5. **Other Related Experience**:
Teaching
Lakehead University, Thunder Bay, Ontario, Associate Professor of Electrical Engineering, 1974-1987

Industrial
Bell Northern Research, Ottawa, Ontario, Member of Scientific Staff, 1972-1974

6. **Consulting**:
Atlas Technologies, Fenton, Michigan, Simulation of Hybrid Tandem Press Line, 1994-1995
General Motors Technical Center, Warren, Michigan, Incorporation of GPS into a Vehicle Navigation System, 1991-1992
General Motors Technical Center, Warren, Michigan, Fuzzy Logic Control of a Passive Keyless Entry System, 1991
Great Lakes Forest Products, Thunder Bay, Ontario, Energy Management System, 1985-1987
Ministry of Energy of Ontario, Ontario, Canada, Solar System Monitoring, 1981-1985
Grain Commission of Canada, Thunder Bay, Ontario, Grain Elevator Monitoring System, 1978-1981
MacMillan Bloedel, Powell River, British Columbia, Steam Plant Modeling, 1978
Fleming Systems, Ltd., Thunder Bay, Ontario, Vice President of Engineering, 1977-1987
Thunder Bay Terminals, Thunder Bay, Ontario, Manpower Scheduling System, 1977-1978

7. **Professional Registration**:

8. **Publications**:

9. **Scientific and Professional Society Memberships**:
Institute of Electrical and Electronic Engineers (IEEE)
Professional Engineers of Ontario

10. **Honors and Awards**:
National Research Council Scholarship, 1978-1971
National Research Council Bursary, 1967

11. **Institutional and Professional Service**:
Department
ECE Department Head, 1992-1998

12. **Professional Development**:

Research

Research in Fuzzy Logic Control applied to internal combustion engines

Seminars Attended

Design for Automotive ASIC's, Delco Electronics, Kokomo, Indiana, 1991

Designing Microelectronic Systems using Field Programmable Gate Arrays, University of Tennessee, Knoxville, Tennessee, 1993

Resume
Electrical & Computer Engineering

1. **Name**: James C. McLaughlin **Birth Date**: 08/24/39

2. **Academic Rank**: Associate Professor of Electrical Engineering

3. **Degrees**:

JD		Thomas M. Cooley Law School, Lansing, MI	1985
MSc	Electrical Engineering	Ohio State University	1962
BS	Mathematics	University of Michigan	1960

4. **Years on this Faculty**: Thirty-Nine

Associate Professor of Electrical Engineering	1970
Assistant Professor of Electrical Engineering	1965
Instructor of Electrical Engineering	1964

5. **Other Related Experience**:
Industrial
University of Michigan, Broadcast Engineer, 1962-1964
Ohio State University, Research Associate, 1960-1962
National Radio Astronomy Observatory, Green Bank, West Virginia: Research Assistant, 1959-1960

6. **Consulting**:
EMC Project for Advance Product Engineering, GM Engineering Staff, Flint, Michigan
Genesee County Purchasing Agent, Flint, Michigan: continuous tone squelch and search lock
Flint Police Department, Flint, Michigan: radio communication interference
AC Spark Plug, Flint, Michigan: piezoelectric crystals and crystal oscillators
Patenting inventions from many different technologies

7. **Professional Registration**:
Professional Engineer, Michigan
Attorney-at-Law, Michigan
Patent Attorney, U.S. Patent and Trademark Office

8. **Publications**:
One of several co-authors of an ABA booklet for inventors
Co-author of a paper in Precision Shooting on the Development of a Long Range Target Rifle
Presenter of an invited paper to USAF Communication Agency on the optimization of Short and Medium Range HF Communication

9. **Scientific and Professional Society Memberships**:
Mathematical Association of America
American Intellectual Property Law Association
Applied Computational Electromagnetics Society

10. **Honors and Awards**:

11. **Institutional and Professional Service**:
Institute Committees
Faculty Senate
Academic Computer Committee
Chairman, Intellectual Property Subcommittee

Department Committees
Laboratory Committee

Faculty Advisor
GMTE Amateur Radio & Electronics Club

12. **Professional Development**:
Modeling and Optimization of Antennas
Keeping Current with the Arts

Resume
Electrical & Computer Engineering

1. **Name**: Douglas E. Melton **Birth Date**: 05/11/1965

2. **Academic Rank**: Associate Professor of Electrical Engineering

3. **Degrees**:

PhD	Electrical Engineering	University of Wisconsin	1993
MS	Electrical Engineering	The Ohio State University	1988
BS	Electrical Engineering	The Wichita State University	1987

4. **Years on this Faculty**: Seven
Associate Professor of Electrical Engineering 1999
Assistant Professor of Electrical Engineering 1995

5. **Other Related Experiences**:
Industrial
Digisonix, Incorporated: Research and Development Engineer, Senior Research Development Engineer, Manager of Research and Development, Manager of Software Development Products, 1990-1994
Continuing Education
Delphi, Inc., Kokomo, Indiana: Introduction to Mobile Multimedia, 1999-2003
Delphi, Inc., Kokomo, Indiana: System Modeling, 1999-2001
Delco Electronics, Inc., Kokomo, Indiana: Digital Signal Processing, March 1997
Bosch, Inc., GMI, Flint, Michigan: Digital Control Systems, May 1997

6. **Consulting**:
Bosch Corporation, 1996, Development of Software Component in Microprocessor-Based Data Collection System for Antilock Brake Modules

7. **Professional Registration**:

8. **Publications**:
Melton, Douglas E., **Integrating Sound Control in an Undergraduate Digital Signal Processing Curriculum**, *ASEE Regional Conference*, North Central Section, Ferris State University, April 1996
Popovich, S.R., Melton, D.E., and Allie, M.C., **New Adaptive Multi-Channel Control Systems For Sound and Vibration**, *Proceedings of Internoise* ’92, July 1992
Melton, D.E. and Greiner, R.A., **Adaptive Feedforward Multiple-Input, Multiple-Output Active Noise Control**, *Proceedings of ICASSP ’92*, San Francisco, March 1992
Patents:
Goodman, S., Eriksson, L., Melton, D.E., and Braun, E., *Transducer Daisy Chain*, Patent #5,570,425, October 1996
Melton, D.E., *Multi-Channel Active Acoustic Attenuation System*, U.S. Patent #6,216,721, June 1993

9. **Scientific and Professional Society Memberships**:
Institute of Electrical and Electronic Engineers (IEEE)

10. **Honors and Awards**:
Outstanding Teaching Award, 1999

11. **Institutional and Professional Service**:
Department
Chairman, Graduate Program Committee

Institute Committees
Chairman, Graduate Policies Development and Review Committee (GPDRC)
Foundations Program Faculty Advisor

12. **Professional Development**:
Seminars Attended
ASEE National Effective Teaching Institute (NETI), Milwaukee, Wisconsin, June 1977
ASEE Regional Conference, North Central Section, Ferris State University, 1996
Developed Web-Page for ECE Department, 1997

Resume
Electrical & Computer Engineering

1. **Name**: Karen Irene Palmer **Birth Date**: 09/05/1963

2. **Academic Rank**: Associate Professor of Electrical Engineering

3. **Degrees**:

PhD	Mechanical Engineering	Massachusetts Institute of Technology	1995
MS	Mechanical Engineering	Massachusetts Institute of Technology	1990
BS	Electrical Engineering	GMI Engineering & Management Institute	1986

4. **Years on this Faculty**: Eight
Associate Professor of Electrical Engineering 2000
Assistant Professor of Electrical Engineering 1995

5. **Other Related Experience**:
Industrial
Experimental Engineer, Light Truck Electrical Development, General Motors Corporation, Truck & Bus Group, Pontiac, Michigan, June 1986 - August 1988
Cooperative Education Student, GM Truck & Bus Group, June 1981 - June 1986

6. **Consulting**:

7. **Professional Registration**:

8. **Publications**:
Palmer, K.I., Rust, L.M., and Schulz, M.S., **Predicting Failures in Lead-Screw Applications Using the Wavelet Transform**, *The International Conference on Signal Processing Applications and Technology 1999*, November 1999, Orlando, Florida.
Rust, L.M., Palmer, K.I., and Finelli, C.J., **Energized Enigma**, *The 1999 Frontiers in Education Conference*, November 1999, San Juan, Puerto Rico.
Rust, L.M., Palmer, K.I., and Finelli, C.J., **Electrical Escapades**, Engineering the Future: Introducing pre-college students to engineering through interactive activities. *ASEE Division of Women Engineering Workshop*, June 1998, Seattle, Washington.
Palmer, K.I., **Time-Frequency Variations in Cerebellar Intention Tremor and Prediction of Drug from Limb Loading Results**, PhD Thesis, Massachusetts Institute of Technology, Cambridge, Massachusetts, June 1995.
Durfee, W.K, and Palmer, K.I., **Estimation of Force-Activation, Force-Length, and Force-Velocity Properties in Isolated, Electrically Stimulated Muscle,** *IEEE Transactions on Biomedical Engineering*, Vol. 41, No. 3., pp. 205-216, 1994.
Palmer, K.I., **Characterizing Pathological Tremor – Can Drug Efficacy be Predicted?**, *Advances in Rehabilitation Engineering Conference*, West Roxbury, Massachusetts, March 1994.
Palmer, K.I., **Measured Performance of a Limb-loader for Neurological Evaluation of Tremor***, Annual Fall Meeting of the Biomedical Engineering Society*, Memphis, Tennessee, October 1993.

9. **Scientific and Professional Society Memberships**:
The Society of Sigmi Xi
Eta Kappa Nu
Tau Beta Pi
Phi Eta Sigma
ASEE – American Society of Engineering Educators

10. **Honors and Awards**:

11. **Institutional and Professional Service**:
Institute Committees
Faculty Advisor – Beta Sigma Phi Sorority
APAP – Academic Policies & Procedures

Department Committees
Curriculum Committee
Faculty Search Committee

12. **Professional Development**:

Resume
Electrical & Computer Engineering

1. **Name**: Laura M. Rust **Birth Date**: 12/11/1959

2. **Academic Rank**: Associate Professor of Electrical Engineering

3. **Degrees**:

PhD	Electrical Engineering	New Mexico State University	1994
MSEE	Electrical Engineering	New Mexico State University	1987
BSEE	Electrical Engineering	Washington State University	1983

4. **Years on this Faculty**: Seven
Associate Professor of Electrical Engineering 2000
Assistant Professor of Electrical Engineering 1995

5. **Other Related Experience**:
Industry
Science and Technology Corporation, September – December 1987
Lockheed Engineering and Management Services Company, July 1985 – September 1987
Texas Instruments, Incorporated, July 1983 – July 1985
Teaching
New Mexico State University, College Instructor, January 1988 – June 1995

6. **Consulting**:
White Sands Missile Range Atmospheric Research Laboratory, 1995

7. **Professional Registrations**:
E.I.T. 1983

8. **Publications**:
Palmer, K.I., Rust, L.M., and Schulz, M.S., **Predicting Failures in Lead-Screw Applications Using the Wavelet Transform,** *The International Conference on Signal Processing Applications and Technology 1999*, November 1999, Orlando, Florida.
Smolleck, H.A., Dwyer, D.S., and Rust, L.M., **On-Screen Synthesis and Analysis of Harmonics: A Student-Oriented Package**, *IEEE Transactions on Education*, August 1995, Vol. 38, No. 2, pp. 243-251.
Rust, L.M., Smolleck, H.A., Dwyer, D.S**., Some Applications and Observations on the Use of a New Harmonic Analysis and Synthesis Demonstrator**, *Proceedings of the ASEE Gulf-Southwest Section Meeting*, April 1993, pp. 582-588.
Rust, L.M., and Jordan, J.B., **Recursive Bayesian Estimation of Effective Defibrillation Shock Intensities**, *Proceedings of the Annual International Conference of the IEEE EMBS*, October 1991, Vol. 2, pp. 640-641.

9. **Scientific and Professional Society Memberships**:
Institute of Electrical and Electronic Engineers (IEEE)

10. **Honors and Awards**:
NSF Engineering Research Center Doctoral Fellow, Duke University, North Carolina, 1990-1992

11. **Institutional and Professional Service**:
Department Committees
Curriculum Committee
University Committees
GPDRC

12. **Professional Development**:

Resume
Electrical & Computer Engineering

1. **Name:** Mark G. Thompson **Birth Date:** 07/08/1954

2. **Academic Rank:** Professor of Electrical Engineering

3. **Degrees:**

PhD	Electrical Engineering	Michigan State University	1980
MS	Electrical Engineering	Michigan State University	1977
BS	Electrical Engineering	Michigan State University	1976

4. **Years on this Faculty:** Fourteen

Professor of Electrical Engineering	1993
Associate Professor of Electrical Engineering	1988

5. **Other Related Experience:**

Teaching

Michigan Technological University, Houghton, Michigan, Assistant Professor, Department of Electrical Engineering, 1980-1987

Michigan State University, East Lansing, Michigan, Graduate Research & Teaching Assistant, Department of Electrical Engineering and Systems Science, 1976-1980

Michigan State University, Engineering Aide, Department of Engineering Services, 1975-1976

6. **Consulting:**

Delco Electronics, Kokomo, Indiana. Continuing education course development and delivery, 1999-present. *Electronic System Simulation and Analysis Methods using Saber.*

7. **Professional Registration:**

8. **Publications:**

King, L.S.B., Riffe, W., Tuttle, B.L., Kowalski, H., Lemke, B., El-Sayed, J., Melton, D., Rust, L., Thompson, M., **Building a Process for Establishing an Interdisciplinary Design and Manufacturing Freshman Course**, *Proceedings of the 2003 ASEE Annual Conference*, Nashville, Tennessee, June 22-25, 2003.

Devereux, U., Rericha, N., Todd, N., Douglas, A., Hribar, J., and Thompson, M., **Electric Bike Design**, *Proceedings of the EMCW'00 Conference*, Cincinnati, Ohio, October 31-November 2, 2000.

Carroll, B., Klug, D., Dimitrov, L., Marmara, S., Montemayor, R., Shaffer, A., Shaub, P., Tse, E., and Thompson, M., **Design of a Motor Speed Controller for a Lightweight Electric Vehicle**, *Proceedings of the EIC/EMCW'99 Conference*, Cincinnati, Ohio, October 26-28, 1999.

Heil, E., Jordan, C., Nasr, K.J., Plagens, K.M., Tavkoli, M., Thompson, M., and Wolak, J., **An Electric Vehicle with Racing Speeds**, *Proceedings of the SAE International Congress and Exposition*, Detroit, Michigan, February 23-26, 1998.

Torfeh, M., and Thompson, M., **University Saber Programs**, *Proceedings of ASSURE*, Saber Users Group, Automotive Special Interest Group Meeting, October 23, 1998.

Wolak, J., Cook, J., Van Hoven, J., Kalinowski, A., Mosher, P., Munger, G., Nguyen, T., Trembly, J., Heil, E., Joye, J., Wandri, H., Jordan, C., Tavakoli, M., and Thompson, M., **Development of High Speed Electric Vehicle Technology**, *Proceedings of HEV and EV Racing Symposium II,* Cincinnati, Ohio, October 5, 1998.

Nasr, K., Tavakoli, M., Thompson;, M., and Jordan, C., **High Speed Electric Vehicle**, *Proceedings of 32nd Intersociety Energy Conversion Engineering Conference*, Honolulu, Hawaii, 1997.

Finelli, C.J., and Thompson, M**., Integrating Biomedical Signal Processing into an Undergraduate Curriculum**, *Proceedings of the 1996 ASSE North Central Section Conference,* Big Rapids, Michigan, 1996.

Thompson, M., and Johnson, D., **Experience with an Undergraduate Semiconductor Characterization Laboratory**, *1995 ASEE Annual Conference Proceedings*, Anaheim, California, 1995.

Johnson, D., and Thompson, M., **Shedding Light on Black Boxes: Undergraduate Semiconductor Characterization**, *1994 ASEE Annual Conference Proceedings*, Calgary, Canada, 1994.

Thompson, M., and Johnson, D., **Undergraduate Semiconductor Characterization Laboratory**, *Proceedings of 1994 ASEE North Central Section Conference*, Grand Rapids, Michigan, 1994.

9. **Scientific and Professional Memberships**:
American Society for Engineering Education (ASEE)
Society of Automotive Engineers (SAE)

10. **Honors and Awards**:
Most Outstanding Professor, Tau Beta Pi, GMI Engineering & Management Institute, 1991
Best Paper Award, American Society for Engineering Education North Central Section Conference, 1991
Teetor Distinguished Engineering Educator Award, Society of Automotive Engineers, 1987
Outstanding Professor of Electrical Engineering, Eta Kappa Nu, Michigan Technological University, 1984
Tau Beta Pi (Engineering Honorary)

11. **Institutional and Professional Service**:
Course Coordinator
EE-490, Senior Electrical Engineering Design Project
EE-426, Solid State Devices
EE-420, Electronics II
EE-580, Automotive Electronic Systems
Department Committees
Graduate Curriculum Subcommittee
EE Senior Design Assessment Committee Chair
Ad Hoc Department Head Search Committee Chair, 97-98
Laboratory Committee Chair
Promotion Committee
Institute Committees
Organization and Coordination Committee
International Programs Committee
1999-2000 Faculty Senate
Faculty Advisor
Kettering University Electric Formula Lightning Team
Tau Beta Pi, Michigan Zeta Chapter

12. **Professional Development**:
Seminars Attended
EIC/EMCWA Annual Conference, Cincinnati, Ohio, 2002
EMCWA Annual Conference, Cincinnati, Ohio, 2000
EIC/EMCWA Annual Conference, Cincinnati, Ohio, 1999
EMCWA Annual Conference, Cincinnati, Ohio, 1998
HEV and EV Racing Symposium II, Cincinnati, Ohio, 1998
ASSURE, Automotive Special Interest Group Meeting, Livonia, Michigan, 1998
ASEE North Central Section Conference, Big Rapids, Michigan, 1996
ASEE Annual Conference, Anaheim, California, 1995
ASEE North Central Section Conference, Grand Rapids, Michigan, 1994

Resume
Electrical & Computer Engineering

1. **Name**: Mohammad Torfeh-Isfahani **Birth Date**: 12/31/1954

2. **Academic Rank**: Professor of Electrical Engineering

3. **Degrees**:

PhD	Electrical Engineering	Wayne State University	1982
MS	Electrical Engineering	Wayne State University	1979
BS	Applied Mathematics	University of Isfahan, Tehran, Iran	1977

4. **Years on this Faculty**: Twenty

Professor of Electrical Engineering	1991
Associate Professor of Electrical Engineering	1986
Assistant Professor of Electrical Engineering	1982

5. **Other Related Experience**:

Teaching

GM Technical Center, Warren, Michigan: Graduate electrical engineering courses in robotics and vision systems; design of computer based systems; computer aided circuit and system design and local area networks, 1982 to present.

GM Delco Division: System analysis techniques and digital control theory, 1995 to present.

Continuing Education

Kettering University: Coordinator of continuing education, January 2002 to present.

GM Technical Center: Courses in design and application of microcomputer-based systems, artificial intelligence, and digital signal processing, 1984 to present.

GM Delphi, Kokomo, Indiana: System engineering courses, 1984 to present.

6. **Consulting**:

Robert Bosch Corporation, 1991-1997, Antilock Brake System Design and Analysis

GM, Bosch, and Delphi-Delco: Coordinating several research projects.

7. **Professional Registration**:

8. **Publications**:

Della Torre, E., Gupta, M., and Torfeh-Isfahani, M., **Amode Pushing – A Practical Algorithm for Accelerating Slowly Convergent Iterations**, submitted for publication *to ACM Transaction of Mathematical Software.*

9. **Scientific and Professional Memberships**:

Institute of Electrical and Electronic Engineers (IEEE)

Eta Kappa Nu

Tau Beta Pi

10. **Honors and Awards**:

Vision System from GM Technical Center; donation value $45,000, 1990
Outstanding Teaching Award from SAE, 1987
Outstanding Engineering Educator of the Year Award from National SAE, 1987
Outstanding Teaching Award, GMI Alumni Association, 1986
Rhodes Professorship Award for $5,000 for Research on Flexible Design of Digital Controllers, 1986
Puma 560 Robot for Basic Research in Smooth Trajectory Generation, 1986
Outstanding Teaching Award, GMI Alumni Foundation, 1985
MCSYM200 Computer System for Process Monitoring and Control, 1985
Intel System 310 (80286 based system) for Control Systems Simulation for Robot Manipulators, 1983
Systems and Components from Intel Corporation for Computer Architecture Projects and New Course Development; average yearly donation of $45,000, 1983-1990
National Science Foundation Scholarship for Graduate Studies, 1979-1982

11. **Institutional and Professional Service**:

Course Coordinator
EE-582, Robot Dynamics and Control
Department Committees
Student-Faculty Committee
University Committees
Academic Computer Committee
Library Advisory Committee
University Council Committee
Honorary Degree Committee Chair
Faculty Advisor
EE Study Abroad Program
Delta Tau Delta
IEEE Student Society

12. **Professional Development**:

Adaptive Control System Research

Resume
Electrical & Computer Engineering

1. **Name**: Ravi K. Warrier — **Birth Date**: 06/11/1950

2. **Academic Rank**: Professor of Electrical Engineering

3. **Degrees**:

PhD	Electrical Engineering	University of New Mexico	1985
MS	Electrical Engineering	University of New Mexico	1980
BS	Electrical Engineering	University of Calicut, India	1972

4. **Years on this Faculty**: Seventeen

Professor of Electrical Engineering	1994
Associate Professor of Electrical Engineering	1989
Assistant Professor of Electrical Engineering	1986

5. **Other Related Experience**:

Teaching
Teaching Assistant, University of New Mexico, Albuquerque, New Mexico, 1979-1985
Continuing Education
GM Delphi and GM Technical Center: System Simulation and Modeling, System Analysis Techniques Digital Control Systems, Digital Signal Processing, and PID Controllers.
Industrial Experience
Plant Engineer, Abu Dhabi Oil Company Ltd, Abu Dhabi, United Arab Emirates, 1974-1978
Other
EE Curriculum Development
EE Program Assessment
EE Course Scheduling
Student Advising

6. **Consulting**:

7. **Professional Registration**:

8. **Publications**:

Gover, J.E. and Warrier, R., **The Healthcare Cost Problem: Role of Kettering University**, an internal research paper presented to Kettering University, 2000
Chakravarthy, S. and Warrier, R., **A Stochastic Model for a Computer Communication Network Node with Phase Type Time-Out Periods**, published *in Numerical Solution of Markov Chains*, 1991, Marcel Dekker, Inc.
Warrier, R., **Circuit Theory** (Textbook in Progress)
Warrier, R**., EE-230, Signal & Systems** (Notes developed to be converted to textbook)

9. **Scientific and Professional Society Memberships**:

Institute of Electronic and Electrical Engineers (IEEE)

10. **Honors and Awards**:

Elanix Incorporated, System View Software, 2001
Phi Kappa Phi
Eta Kappa Nu

11. **Institutional and Professional Service**:
Department Committees
Director/Chair Electrical Engineering Program
Curriculum Committee Chair
EE Assessment Committee Member
Faculty Search Committee

Course Coordinator
EE-210, Circuits I
EE-211, Circuits I Lab

Institute Committees
Senator

12. **Professional Development**: