UNIVERSITY OF CALIFORNIA
UC RIVERSIDE
BOURNS COLLEGE OF ENGINEERING

Computer Engineering

Response to ABET EAC Final Statement of August 13, 2007:
Criteria 2 and 3 Weaknesses

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Chapter 1

Final Statement on Computer Engineering

Per EAC's Final Statement of 2007:

> **Computer Engineering (BS)**
> **Electrical Engineering (BS)**
>
> > Accredit to September 30, 2009. A request to ABET by January 31, 2008 will be required to initiate a reaccreditation report evaluation. A report describing the actions taken to correct shortcomings identified in the attached final statement must be submitted to ABET by July 1, 2008. The reaccreditation evaluation will focus on these shortcomings. Please note that a visit is not required.

The identified "Program Weaknesses" of Computer Engineering are:

1. Criterion 2. Program Educational Objectives. Criterion 2 states, "... program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve." The program's objectives are not broad statements that describe the accomplishments of computer engineering graduates and their achievements; instead they describe skills more appropriately articulated in program outcomes. In addition, it is not clear that these objectives were reached based on the needs of program constituents (students, faculty, employers, advisory boards, and the community at large). Since these objectives were not defined based on the needs of program constituents, it is not clear how the results are used to improve program outcomes and for graduates to attain the objectives.

- Due-process response: The EAC acknowledges receipt of documentation describing a proposal for a new set of educational objectives that are focused on early career accomplishments. It also proposes a process for involvement of constituents in refining/approving the objectives. The documentation indicates a May 2007 date for completion of the educational objectives review, refinement and approval process.
- The weakness remains unresolved and will be the focus of the next review. In preparation for the review, the EAC anticipates evidence documenting the implementation of the new process.

2. Criterion 3. Program Outcomes and Assessment Criterion 3 states, "There must be processes to produce these outcomes and an assessment process, with documented results, that demonstrates that these program outcomes are being measured and indicates the degree to which the outcomes are achieved. There must be evidence that the results of this assessment process are applied to the further development of the program." Course objectives are defined for each course but they are not clearly related to program outcomes that are referred to as departmental outcomes. It is stated in the report that the college will administer a new assessment tool in the fall of 2006 but the process used presently in measurement of program outcomes is not documented. Achievement of program outcomes is demonstrated using course objectives and grades in homework assignments and exams. Sufficient evidence was not provided to demonstrate students attain the outcomes articulated by the computer engineering program.
   - Due-process response: The EAC acknowledges the receipt of documentation that references the self-study and onsite documentation related to correlation between course content and program outcomes. The documentation also identified additional assessment planned in the future. It provided no additional information related relating [sic] course content to outcomes or of the use of assessment data to improve the program.
   - The weakness remains unresolved and will be the focus of the next review. In preparation for the review, the EAC anticipates evidence that documents the relation of specific course content and grades to program outcomes, evidence documenting implementation of additional assessment tools identified in the due-process response as well as evidence that the results of assessments have been used to improve the program.

Chapter 2

Corrective Action Regarding Criterion 2

The 2007 ABET review noted the following weaknesses:

1) **Criterion 2: Program Educational Objectives:** *The program's objectives are not broad statements that describe the accomplishments of computer engineering graduates and their achievements: instead they describe skills more appropriately articulated in program outcomes. In addition, it is not clear that these objectives were reached based on the needs of program constituents. It is not clear how the results are used to improve program outcomes and for graduates to attain the objectives.*

The department fully agrees that this was a true weakness. Here is how we addressed it.

In late October 2007, the two faculty members most responsible for ABET, Dr. Eamonn Keogh and Dr. Tom Payne, had a series of meetings with the interested parties, including the CE Assessment and Accreditation committee, the EE Assessment and Accreditation committee (Dr. Amit K. Roy-Chowdhury and Dr Roger Lake), the CE Undergrad education committee and the Chair of CS&E, Dr. Laxmi Bhuyan (note that we have undergone a change of Chair since the ABET visit). The old PEOs are attached as **Appendix A** to this document.

On November 6 2007, Dr. Eamonn Keogh and Dr. Tom Payne wrote new PEOs. They based them very closely on the EE PEO. The Electrical Engineering Department was consulted and asked for feedback at this stage.

On November 8 2007, Dr. Eamonn Keogh presented the new PEOs to the CSE Board of Advisors, from 1:00pm to 1:30pm. Each member got a take home copy, and was invited to discuss the PEOs both at the meeting, and offline by email at a later date. Dr. Keogh also discussed ABET more generally, and with Dr. Neal Young discussed the undergraduate program in general. Andrea Gonzales took minutes. Supporting documentation for this is attached as **Appendix B** to this document.

On November 14 2007, Dr. Eamonn Keogh presented the new PEOs with notes from the Board of Advisors to the entire CS&E faculty, 40 minutes were spent discussing the PEOs and they were adopted by a majority vote. The minutes of this meeting are detailed in **Appendix C**.

Dr. Eamonn Keogh solicited feedback and approval for our new PEOs from employers of our CE students. This process was conducted by phone, email and when possible, by an onsite visit by a delegation from our department. This is documented in **Appendix E**.

We also solicited comment and approval for our new PEOs from our students, this is documented in **Appendix D**.

In summary, we created new PEO after soliciting input and approval from all our constituents, our Board of Advisors, employers of our students, faculty, and the students themselves. Furthermore, we have carefully documented this process at every step. Table 1 contains the new Program Educational Objectives.

Table 1: The new Program Educational Objectives

Graduates of UCR's BS degree program in Computer Engineering will meet high professional, ethical, and societal goals as demonstrated by:

success in *post-graduation studies as evidenced by*:

- satisfaction with the decision to further their education
- advanced degrees earned
- professional visibility (e.g., publications, presentations, patents, inventions, awards)
- professional responsibilities (e.g., professional mentoring, professional society membership and offices, reviewing and editorial work for professional journals)

success in *a chosen profession or vocation as evidenced by*:

- career satisfaction
- promotions/raises (e.g., management leadership positions or distinguished technical positions)
- professional visibility (e.g., publications, presentations, patents, inventions, awards)
- professional responsibilities (e.g., professional registration, professional mentoring, professional society membership and offices)
- entrepreneurial activities
- consulting activities

contributions to society as evidenced by:

- leadership roles
- public service
- mentoring / outreach activities
- volunteer service

When creating the new PEOs we consider *measurability* at every step. We believe that we can measure each and every bulleted item with *objective* metrics.

To this end, we have implemented a process for evaluating the success of the PEOs through regular surveys of our alumni and industry representatives who are the employers of our former students (note that our definition of "employer" includes graduate student supervisors at grad school). The questionnaire prepared for surveying the alumni is documented in Table 2 . This survey was created by a joint effort between the Computer Science and Engineering Department and the Electrical Engineering Department. The meeting to create the questionnaire was held on February 22th 2008. In attendance were Mitch Boretz, Roger Lake, Amit Roy-Chowdhury, Tom Payne, Eamonn Keogh, Marc Deshusses, Tim Willette, Chinya Ravishankar, Reza Abbaschian, William Bingham, Jackie Li, Roseanna Barron-Lopez and Denise Sanders. After the meeting was held and a tentative draft of the questionnaire was created, the draft was sent to all CE/CS/EE faculty for comments and suggestions. These suggestions were discussed and incorporated at a follow-up meeting.

This survey will be conducted annually. It is initiated by sending an email invitation from the Department Chair to all of our alumni and their employers. A database of alumni and their employers has been created for this purpose and will be maintained at the college level.

Based on these sources of feedback, we have implemented a process of improving our program so as to better attain the objectives. The process for this implementation is as follows. Once the survey results come in, the CS&E department's undergraduate education committee reviews the results and suggestions and comes up with a tentative list of changes that may be useful. The committee works with the rest of the CE faculty to develop the best method for implementing the changes. These are then brought forward for discussion at the CS&E departmental faculty meeting. Once faculty approval is obtained, the implementation process starts. Depending upon the nature of the change, the process may require approval by the Academic Senate of the university or other interested parties or sub-committees. Documentation of all the changes made to our program and how they affect the PEOs is being maintained, and a subset of this documentation is contained in this corrective-action report. Note that this process is part of our more general program iterative improvement process documented in Figure 1 and discussed later in this document.

The 2008 survey was opened in late April 2008. As of June 1 there were a total of 17 respondents. Given the relative youth of our program, we consider this a good response rate; however we are considering ways to dramatically increase the response rate in future years.

The results were obtained too late to be discussed in a faculty meeting in the 2007-2008 academic year. However, 45 minutes have been assigned to discuss the results in the department retreat at the beginning of the 2008-2009 academic year (date TBD). Furthermore, the raw data, and a summarized and annotated version of the data was sent to all faculty on June 11, 2008.

In Table 2, we show the questions in the survey, together with the responses, and annotation to explain the relevance to our PEOs and to the ABET (a) through (k) outcomes.

Table 2: The CE Alumni Survey, annotated by relevance to our Program Educational Objectives and to the ABET (a) through (k) outcomes, with the results of the Spring 2008 survey.

1. What year did your earn your bachelor's degree in Computer Engineering? (Bookkeeping question only) 2007(**4**), 2006(**0**), 2005(**8**), 2004(**1**), 2003(**1**), 2002(**3**): This totals 17 respondents, which, given the relative youth of our program, we consider a good response rate Nevertheless, we have decided to put significant resources into maintaining a database of alumni the college level to improve the response rate for future years.
2. Have you pursued or completed any degrees beyond your bachelor's degree in engineering from UCR? **Yes, No** (Bookkeeping question only, to bifurcate the following questions into those that have had graduate education and those that have not) 56.3% said **yes**: While we understand the possibility of selection bias, we are very pleased that more than half our students go on to grad school.
3. If you have completed another degree, please indicate all degrees completed. **M.S., Ph.D., MBA, J.D., M.D.** **Other (please specify)** (This question maps onto ABET (i) directly, and to directly onto PEO "satisfaction with the decision to further their education" and "advanced degrees earned") MS 57%, Other 43%, the two free text responses are "*PMP (Project Manager Professional) Certificatio*n" and "*Certification*": Given how recent these graduates are (see question 1), and the response to the next question, we believe that many of these "MS" responses will turn to "PhD" in future years.
4. If you are pursuing another degree, please indicate the degree you are pursuing. **M.S., Ph.D., MBA, J.D., M.D.** **Other (please specify)** (This question maps onto ABET (i) directly, and to directly onto PEO "satisfaction with the decision to further their education" and "advanced degrees earned") MS 66.7%, PhD 50.0% (since these choices are not mutually exclusive, they may sum to greater than 100%)
5. Have you published articles and/or made presentations at conferences in your field? **Yes, No** **If yes, approximately how many?** (This question maps onto ABET (g)(j)(a)(b) and (c) directly, and to directly onto PEO "success in post-graduation studies as evidenced by professional visibility") 44.4% **Yes**, with two individuals reporting they had published 5 papers. Given the recentness of graduation for most of our students, and the publication delays for research articles, this figure is impressive.
6. Have you been named on any patents or patent applications? **Yes, No** (This question maps onto ABET (c)(g)(j)(a) and (k) directly, and to directly onto PEO "success in post-graduation studies as evidenced by professional visibility-patents") O% **Yes**. Given that such a large fraction of our students are currently pursuing third level education, and students are rarely encouraged/allowed to patent things, we are not too disappointed with this number.

7. Have you received any awards for professional achievement?
Yes, No, If yes, please describe
(This question maps onto ABET (a) and (e) directly, and to directly onto PEO "success in post-graduation studies as evidenced by professional visibility-awards")

22% **Yes**, with annotations "*Awarded: Lean Six Sigma Award by the Secretary of the Navy*" and "*I have received over 40 awards from various politicians and organizations.*"

8. Have you engaged in any international research or collaborations (e.g., presented at international conferences, worked with international collaborators)?
Yes, No, If yes, brief description of international activities
(This question maps onto ABET (d)(g) and (i) directly, and to directly onto PEO "success in post-graduation studies as evidenced by professional visibility")

22% **Yes**, with annotations "*Traveled to Taiwan to assist in hardware design and complete firmware design for a project.*" and "*Presented several papers at the conference DATE (Design and Automation in Europe) in 2007.*"

9. Have you been a program committee member or organizing committee member of a conference?
Yes, No, If yes, how many times?
(This question maps onto ABET (f)(g)(i)(h) and (j) directly, and to directly onto PEO "success in post-graduation studies as evidenced by professional visibility-reviewing and editorial work for professional journals")

22% **Yes.**

10. Have you been a reviewer for any journals?
Yes, No, If yes, approximately how many times?
(This question maps onto ABET (f)(g)(i)(h) and (j) directly, and to directly onto PEO "success in post-graduation studies as evidenced by professional visibility-reviewing and editorial work for professional journals")

11% **Yes**

11. Have you engaged in other professional service such as scientific or technical review panels, serving as an expert witness, or consulting?
Yes, No
(This question maps onto ABET (f)(d)(g)(i)(h) and (j) directly, and to directly onto PEO "Public service, leadership roles" and "consulting activities")
22% **Yes**

12. At this point of your career and education, what is the level of your satisfaction with your career choice and success in each of the following?
Very satisfied- 5 4 3 2 1- Not satisfied
The field you work in: 66% scored a '5', and 33 scored a '4'
The academic institution/lab you work in: 75% scored a '5', and 25 scored a '4'
Recognition of your work: 22% scored a '5', 44 scored a '4' and 33% scored a '3'

(This question maps onto ABET (i) directly, and to directly onto PEO "Satisfaction with the decision to further their education" and "professional visibility")

13. While pursuing an advanced degree, have you also been working professionally?
I have only been a student -- skip to Professional and Community questions
I have worked professionally
(Bookkeeping question only, to bifurcate the following questions into those that have had graduate education and those that have not)

62.5% of the students responded "*I have worked professionally*"

14. From the options below, please choose the one that best describes your current work. Engineering support, Engineering development, Engineering management, Engineering research, Technical sales/marketing, Other (please specify)
(This question maps onto ABET (i) directly, and to directly onto PEO "Satisfaction with the decision to further their education" and "leadership roles", and "public service")

Engineering support 0%, Engineering development 53%, Engineering management 15%, Engineering research 15%, Technical sales/marketing 7% Other (please specify) 15%. Of these, one response was "*Top management*" and the other was "*unemployed*".

15. At this point of your career, what is the level of your satisfaction with your career choice and success in each of the following?
The field you work in, The organization you work in, Your salary, Recognition of your work
(This question maps onto ABET (a) *indirectly*, and to directly onto PEO "Satisfaction with the decision to further their education" and "leadership roles", and "professional visibility")

The field you work in: 54% scored a '5', and 23% scored a '4,' and 15% scored a '3', and 7% a '2'
The organization you work in: 54% scored a '5', and 33% scored a '4' and 7% scored a '3' and '1'
Your salary: 23% scored a '5', and 30%, scored a '4' and 30% scored a '3', and 15% scored a '1'
Recognition of your work: 30% scored a '5', and 30%, scored a '4' and 23% scored a '3', and 7% scored a '2', and 7% scored a '1'

16. Have you had promotions and/or raises since beginning your professional career?
Yes, No, If yes, how many times?
(This question maps onto ABET (a)(b)(c) *indirectly*, and to directly onto PEO "Satisfaction with the decision to further their education" and "promotions raises")

67% **Yes**

17. Have you published articles or made presentations in your organization or in your profession?
Yes, No
(This question maps onto ABET (g)(i)(j) directly, and to directly onto PEO "Professional visibility-presentations-publications")

41% **Yes**

18. Have you engaged in international activities such as participation in international conferences, collaborative research, or employment abroad?
Yes, No
(This question maps onto ABET (i)(g)(d) directly, and to directly onto PEO "Professional visibility")

16% **Yes**

19. Have you made inventions and/or been listed on patents or patent applications?
Yes, No
(This question maps onto ABET (c)(g)(j)(a) and (k) directly, and to directly onto PEO "success in chosen profession or vocation as evidenced by professional visibility-patents")

0% **Yes**

20. Have you been nominated for any professional or academic awards?
Yes, No, If yes, please describe. How many? Did you win?
(This question maps onto ABET (a) and (e) directly, and to directly onto PEO "success in chosen profession or vocation as evidenced by professional visibility-awards")

25% **Yes**

21. Have you mentored others, either inside or outside your organization?
Yes, No, Comments
(This question maps onto ABET (g)(d)(f) and (j) directly, and to directly onto PEO "mentoring/outreach services" and "Volunteer services")

75% **Yes**

22. Have you led groups or teams on projects or new initiatives?
Yes, No, Comments
(This question maps onto ABET (g)(h) and (d) directly, and to directly onto PEO "entrepreneurial activities", "professional visibility" and "leadership roles")

50% **Yes**

23. Have you engaged in any start-up businesses or been involved in any new ventures in your organization?
Yes, No, If yes, please describe
(This question maps onto ABET (e) and (h) directly, and to directly onto PEO "entrepreneurial activities", "leadership roles")

33% **Yes**

24. In the past year, have you attended any workshops, conferences, symposia, etc., related to your profession?
Yes, No
(This question maps onto ABET (i) directly, and to directly onto PEO "professional responsibilities")

50% **Yes,** annotations include "*Conference FPGA 2008 in Monterrey, Ca DAC 2007 in San Diego, CA DATE 2007 in Nice, France IESS 2007 in Irvine, CA*" and "*CE Tradeshows, Alterra funded Design Conference, Microsoft training for WINCE 6.0*"

25. In the past year, have you taken any classes/courses related to your profession?
Yes, No, If yes, roughly how many?
(This question maps onto ABET (i) directly, and to directly onto PEO "professional responsibilities")

50% **Yes,** annotations include: *I have taken* 3, 9, 1 or 2 *such courses*, and "*As part of the required training for the corporation where I work, I have taken about two dozen online courses relating to CPU architecture, the inner-workings of the FSB, and validation techniques. I have also taken instructor-led courses relating to program security, the QuickPath Interface, assembly language, and C/C++.*"

26. In the past year, have you read any books related to your profession?
Yes, No, If yes, roughly how many?
(This question maps onto ABET (i) directly, and to directly onto PEO "professional responsibilities")

91% **Yes,** annotations include: *I have read* 1, 4 , 15, 12 ,12 "*a lot*", "*hundreds*" and "*If you count programming reference manuals, then yes, I have read a great deal of books related to my profession*."

27. Do you subscribe to any periodicals related to your profession?
Yes, No, If yes, roughly how many?
(This question maps onto ABET (i) directly, and to directly onto PEO "professional responsibilities" and indirectly to PEO "professional society membership")

75% **Yes,** annotations include: *I subscribe to* 1, 1, 2 , 2, 2 ,2, 3, 7

28. Are you a member of any professional societies?
IEEE, ACM, SAE, Other (please specify)
(This question maps onto ABET (i) directly, and to directly onto PEO "professional responsibilities" and indirectly to PEO "professional society membership")

100% IEEE, 40% ACM, 0% SAE, and 10% ASQ (American Society of Quality) and 10% NSBE (National Society of Black Engineers)

29. Have you obtained Professional Engineer certification?
Yes, No, If no, are you pursuing PE certification, or do you plan to?
(This question maps onto ABET (i) directly, and to directly onto PEO "professional responsibilities" and "satisfaction with the decision to further their career")

0% **Yes** with annotations: *"Yes, I plan to", "no, it is mostly pointless if all you want to do is engineering", "still calculating cost-benefit tradeoff", "I do not plan to pursue a PE as it is not as valued in CS", "sure, someday ,maybe", "Not doing engineering work anymore"*

30. Have you been involved in any of the following activities?
Public service, Community leadership roles, Volunteer activities, Mentorship and outreach activities
(This question maps onto ABET (f)(i) and (g) directly, and to directly onto PEO "professional responsibilities" and "Volunteer service/outreach activities/public service")

Public service: 64% **Yes**
Community leadership roles: 57% **Yes**
Volunteer activities: 57% **Yes**
Mentorship and outreach activities: 61% **Yes**

With annotations: *"tutoring at risk youth, habitat for humanity", "Tau Beta Pi community service roles involving all of the above", "contributing to an art organization", "My current employer greatly encourages teams to go commit to volunteer work in the community, and our team is going to help at a local food bank next week. I have also volunteered at a few events where school kids come to our site to learn about what we do"*

31. How would you rate the importance of the following items on your career path?
Very satisfied- 5 4 3 2 1- Not satisfied

- **Basic math and science** 71% (**5**), 21% (**4**), 0.0% (**3**), 0.0% (**2**), 7% (**1**)
- **… beyond math and science** 28% (**5**), 14% (**4**), 35% (**3**), 14% (**2**), 7% (**1**)
- **Core curriculum in your major** 35% (**5**), 57% (**4**), 7.0% (**3**), 0.0% (**2**), 0.0% (**1**)
- **Technical electives** 64% (**5**), 28% (**4**), 0.0% (**3**), 0.0% (**2**), 7% (**1**)
- **Senior Design Project** 57% (**5**), 21% (**4**), 14% (**3**), 0.0% (**2**), 7% (**1**)

Comments
(Note that this is a subjective measure, hence it is not used as part of our formal ABET study. Nevertheless, this question maps onto ABET (h) indirectly, and to indirectly onto PEO "satisfaction with the decision to further their education")

32. How would you rate UCR's effectiveness in preparing you in the following areas?
Very satisfied- 5 4 3 2 1- Not satisfied

- **Basic math and science** 50% (**5**), 43% (**4**), 0.0% (**3**), 7% (**2**), 0% (**1**)
- **… beyond math and science** 42% (**5**), 50% (**4**), 7.0% (**3**), 14% (**2**), 0% (**1**)
- **Core curriculum in your major** 21% (**5**), 50% (**4**), 28% (**3**), 0.0% (**2**), 0% (**1**)
- **Technical electives** 28% (**5**), 57% (**4**), 14% (**3**), 0.0% (**2**), 0% (**1**)
- **Senior Design Project** 36% (**5**), 36% (**4**), 21% (**3**), 7% (**2**), 0% (**1**)

Comments
(Note that this is a subjective measure, hence it is not used as part of our formal ABET study. Nevertheless, this question maps onto ABET (h) *indirectly*, and to *indirectly* onto PEO "satisfaction with the decision to further their education")

33. If you participated in research as an undergraduate, how much did that contribute to your preparation for further pursuits?
Highly positive - 5 4 3 2 1- Highly Negative
25.0% (2), 50.0% (4), 25.0% (2), 0.0% (0), 0.0% (0)

(This question maps onto ABET (d)(e) and (i) directly, and to *indirectly* onto PEO "success in post-graduation studies")

34. Our program is designed to enable a Bourns College of Engineering alumnus to be successful either in pursuing a higher degree or in starting a career in engineering or a related field. Based on your experience, what comments do you have on our program and our objectives?

(This is a generic "catch all" question, the answers to which may have implications for any and all ABET criteria and PEOs)
Annotations:
"*I think the program still need some work, particularly in the realm of professor's seriousness about training good engineers. In order to have high passing grades and focus on their research, I think professors are too quick to acquiesce to student demands for easier tests, curves, and less homework.*"

"*It is a UC, while the administration and course planers may want to prepare students for both professional life and higher education, the people teaching the course have a different idea of how things should be done. Ultimately, the education at UCR is research and higher education oriented, there is very little practical application of the theory, especially in the EE department. What enables the student to work well in the professional environment is the ability to be practical and manage the trade-offs of reality, not just the design. Aside from changing the curriculum, more support of the BCOE student groups is a good thing. It socializes the engineers and it teaches them to work in a team and contribute. It would also be a good idea to have the BCOE sponsor student org projects that are treated like real business projects with plans and designs and DEADLINES. The student orgs get money (it doesn't have to be alot) and experience and the BCOE get problems solved. You could even contract out the design and development service to other departments in the University and make some money for the BCOE*!"

"*It needs to be much, much harder to prepare them for the real world and so employers will value UCR candidates more highly.*"

"*Great experience, has literally given my life a new focus and meaning, I highly recommend to any who ask.*"

"*Good program. Needs improvement in getting graduates with the right types of jobs. I got a degree in Computer engineering, but been doing project management for the last 3 years. I love being a manager, but I think the University should do a better job at providing more opportunities for internships.*"

"*Keep up the good work*"

Finally, we note that the creation of the new PEOs was informed by our understanding and our discussions of the ABET (a) through (k) outcomes. In Table 3 we show the mapping between the two.

Table 3: The Mapping of the new Program Educational Objectives to the ABET (a) through (k) outcomes

Graduates of UCR's BS degree program in Computer Science/Computer Engineering will meet high professional, ethical, and societal goals as demonstrated by:

success in *post-graduation studies as evidenced by*:

- satisfaction with the decision to further their education (i)
- advanced degrees earned (a)(i)(e)
- professional visibility (publications, presentations, patents, inventions, awards) (g)(i)(k)
- professional responsibilities (e.g. professional mentoring, professional society membership and offices, reviewing and editorial work for professional journals) (d)(h)

success in *a chosen profession or vocation as evidenced by*:

- career satisfaction (a)(b)(c)
- promotions/raises (e.g. Management leadership positions or distinguished technical positions) (a)(b)(c)(e)(g)
- professional visibility (publications, presentations, patents, inventions, awards) (g)(i)(k)
- professional responsibilities (e.g. professional registration, professional mentoring, professional society membership and offices) (i)
- entrepreneurial activities (d)
- consulting activities (g)

contributions to society as evidenced by:

- Leadership roles (d)(j)
- Public service (f)(c)
- Mentoring / outreach activities (g)(f)
- Volunteer service (f)

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multi-disciplinary teams

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

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

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

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

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. In addition, an engineering program must demonstrate that its students attain any additional outcomes articulated by the program to foster achievement of its education objectives.

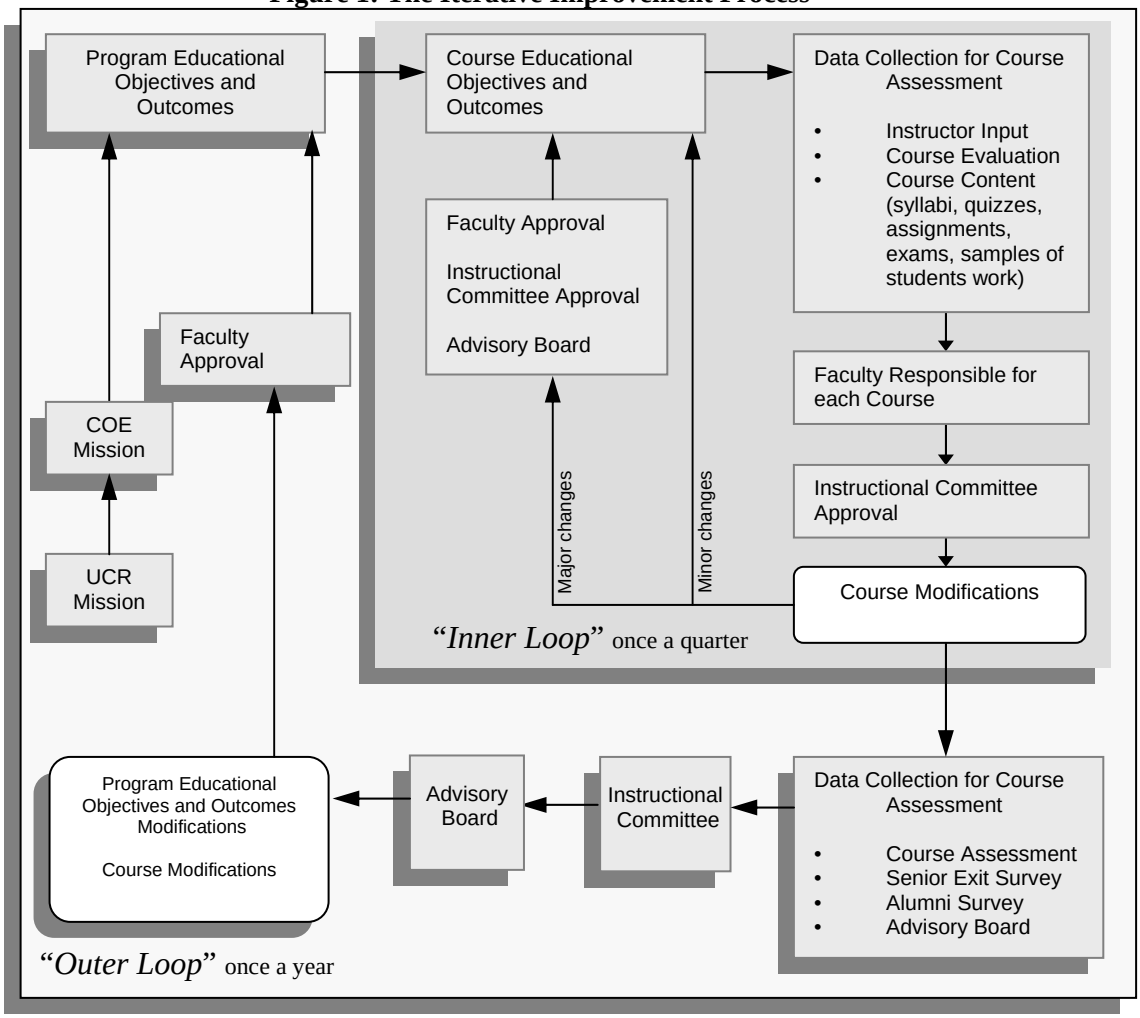
2.1) *How Results are used to Improve Program Outcomes*

The weakness for Criterion 2 also noted: *"It is not clear how the results are used to improve program outcomes and for graduates to attain the objectives."*

In this section we make this clear by discussing our process. Concrete examples are discussed in Chapter 3 of this document, and are not duplicated here for brevity.

The process by which we use data to improve our program is outlined in Figure 1. Note that this process itself is examined once a year for meta-improvements. The process can be seen as an "*inner loop*", which is conducted once a quarter, and an "*outer loop*", which is conducted once a year.

Figure 1: The Iterative Improvement Process



Concrete examples of changes made to improve program outcomes, based on our Iterative Improvement Process, are contained in the Criterion-3 response, in Chapter 3 of this document.

Chapter 3

Corrective Action Regarding Criterion 3

3.1 Items from the Final Statement

Here is EAC's Final Statement regarding Criterion 3, enumerated point by point:

> Criterion 3. Program Outcomes and Assessment Criterion 3 states, *"There must be processes to produce these outcomes and an assessment process, with documented results, that demonstrates that these program outcomes are being measured and indicates the degree to which the outcomes are achieved. There must be evidence that the results of this assessment process are applied to the further development of the program."*
>
> 1. Course objectives are defined for each course but they are not clearly related to program outcomes that are referred to as departmental outcomes.
> 2. It is stated in the report that the college will administer a new assessment tool in the fall of 2006 but the process used presently in measurement of program outcomes is not documented.
> 3. Achievement of program outcomes is demonstrated using course objectives and grades in homework assignments and exams.
> 4. Sufficient evidence was not provided to demonstrate students attain the outcomes articulated by the computer engineering program.
>
> • Due-process response:
>
> 5. The EAC acknowledges the receipt of documentation that references the self-study and onsite documentation related to correlation between course content and program outcomes.

6. The documentation also identified additional assessment planned in the future.
7. It provided no additional information related relating [sic] course content to outcomes or of the use of assessment data to improve the program.

• The weakness remains unresolved and will be the focus of the next review. In preparation for the review, the EAC anticipates

8. evidence that documents the relation of specific course content and grades to program outcomes,
9. evidence documenting implementation of additional assessment tools identified in the due-process response as well as
10. evidence that the results of assessments have been used to improve the program.

3.2 Corrective Action

To remedy its Criterion-3 weakness, UCR's Computer Engineering program (CE) has adopted the outcomes-assessment process of UCR's Electrical Engineering program (EE). This was done for the following reasons:

1. CE is jointly administered by the Department of Electrical Engineering and by the Department of Computer Science and Engineering (CS&E).
2. The engineering portion of CE's curriculum is composed of EE courses, taught by the Electrical Engineering Department, and CS courses, taught by CS&E.[1]
3. The CE and EE programs have the same outcomes, namely ABET's a-k outcomes.
4. Following EE's due-process response, EAC's Final Statement of 2007 judged EE's outcomes-assessment process to fulfill ABET's Criterion-3 requirements:

> *2. Criterion 3. Program Outcomes and Assessment Criterion 3 requires "... an assessment process with documented results, that demonstrates ... program outcomes are being measured and indicates the degree to which the outcomes are achieved." While some assessment has been implemented, it does not appear that all outcomes are sufficiently measured and that achievement of all outcomes is being demonstrated. Sufficient evidence was not provided for the following outcomes: "b" and ability to design*

[1] For historical reasons there are no courses that carry the "CE" designation, but there are some courses that are cross listed as both CS and EE.

and conduct experiments, "d" an ability to function on multi-disciplinary teams, "f" an understanding of professional and ethical responsibility, "h" the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context, "j" a knowledge of contemporary issues.

- *Due-process response: The EAC acknowledges receipt of documentation identifying curricular changes that have been implemented to insure adequate coverage of and documentation of achievement of Criterion 3 items b, d, f, and j. Because the program relies heavily on grading as an assessment tool, outcomes b, d, f, and j now appear to be covered within the curriculum so that better assessment will take place.*
- *The weakness is now cited as a concern pending demonstration of the robustness of the changes.*

The complication of joint administration by two departments is handled as follows. Both departments follow the same (EE's) outcomes-assessment process with analysis and evaluation being performed by their respective Assessment Committees. Recommendations go to their respective faculties. Changes to courses are handle within the corresponding department following standard interdepartmental consultation. Changes to the curriculum must be approved by both departments.

In principle, a change could be approved by one department and denied by the other. That has never happened, and it will be up to the dean to modify the organizational structure if and when such a problem arises.

3.3 CE's Outcomes-Assessment Feedback Process

The inputs to CE's outcomes-assessment feedback process are:

1. For each EE or CS course, student scores on the instruments (homework assignments, lab reports, quizzes and examinations) and/or individual items (homework problems, exam questions, etc.) along with relevance matrices giving the relevance of those instruments and items to the course's objectives. Review of the student performance for feedback on the degree to which the course objectives and program outcomes are being met.

2. Campuswide Student Evaluations of Teaching. Evaluations administered near the end of each quarter allow students to provide the instructor with anonymous feedback on the effectiveness of the course. The questions in the evaluation forms include questions relevant to the stated program objectives like "Have you learned something you consider valuable?" This information is used in UCR's periodic evaluation of its academic personnel.

3. End-of-course student assessments/surveys. Course surveys are distributed at the end of each course. The course survey is based on the course objectives and program's (a-k) outcomes. Students are asked how well the course learning objectives and the program outcomes were achieved.

4. Senior Exit Surveys.[2] The survey allows the graduating seniors to rank how well the program met the program's outcomes. The results of this survey are distributed to the faculty and analyzed. The Undergraduate and Assessment Committees then draft an action plan for improvement.

5. Advice from departments' Boards of Advisors (BOAs). Each year, both departments organize meetings with industry representatives serving on their respective BOAs. The Undergraduate and Assessment Committees are tasked with collecting and analyzing the BOA feedback relative to the content of courses, PEOs, and the a-k outcomes.

6. Quantitative assessment of the Senior Design projects.

7. Alumni Surveys. These surveys are collected from the program's alumni and analyzed with the goal of determining the appropriateness the program objectives and outcomes, as well as the degree to which they are achieved. See Table 2 on page 6.

8. Institutional Data. This data comes from the Campus's Office of Academic Planning and Budget and includes statistical data such as enrollments, aggregated demographic information (e.g., ethnicity and family income), retention rates, time-to-graduation statistics, average GPAs by cohort, etc.

Essentially, this is a quality-control process, similar to ISO 9000 in industry. However, while an industry quality control process deals with some device or gadget as the product, we have a far more complex and more difficult product to measure, i.e. the students. As in every control system, our process involves feedback loops. The inner "micro" loop controls the quality of individual courses, while the outer "global" loop controls the overall program and outcome assessment and improvement process. The two loops operate on different time scales, and are coupled in the sense that one loop can effect change in the other. Below we detail the operation of each loop (process), their inter-relationships, and impact on program outcome assessment.

The per-course assessment, evaluation and, improvement process, depicted in the inner loop, is intimately related to the program outcomes. To facilitate and document this process, the instructor for each course is mandated to prepare and maintain a course file, which includes:

1. Standard Information

    - Course Outline

[2] See Appendix J on 65 for a description and discussion of that survey.

- Course Objectives
- Course Matrix (relevance of each course objective to each program outcome)
- General Syllabus
- Assessment Process

2. For each instrument, including homework assignments, quizzes, midterm, lab assignment, project, and final exam:
   - Copy of the instrument, plus its key or solution if any
   - Copies of graded work (at minimum: best, average, and worst)
   - Scores placed in Grade Book (in Excel format)
3. Relevance Matrix, in Excel format, covering a sufficient number of instruments (exams, labs, and homework assignments) and/or items (exam questions, lab problems, homework problems) to provide a complete coverage of the course objectives.
4. Feedback and Improvement Actions
   - Prior Final Report and "Sign-On"
   - Exit surveys of students and instructors
   - Grade Book showing per instrument score
   - Assessment report (based on student performance, relevance matrix, surveys, etc.)
   - Final report with recommendations for improvement

Prior to the start of the term, each instructor prepares a syllabus, a set of eight (or more) specific course objectives, and a course matrix. A copy of the course objectives is provided to the students in the first week of class, and at the end of the term the students are surveyed on the degree to which they feel they've achieved the course objectives. Including specific course objectives is a useful tool for distilling the course curriculum, and its relationship to the program learning outcomes. In this regard, the course matrix is a key tool for quantifying the relationship between course objectives (and hence curriculum) and program outcomes. An example of a course matrix is shown in Appendix K on page 69.

In addition to the course matrix, another useful tool employed in the course improvement process is the relevance matrix, introduced in 2005 to allow an instructor to correlate the student performance with the course objectives, and hence outcomes (e.g., the average grade for each instrument forms a "row vector" than can multiply the relevance matrix, thus obtaining a vector with each element representing the achievement of the corresponding course objective). These quantitative tools are employed, along with analysis of student exit surveys, for course assessment and evaluation.

At the end of each course, the instructor writes the assessment report, including his/her recommendations for improvement. The instructor is also expected to alert the Assessment Committee of his/her department regarding any concerns about the achievement of the course's objectives and/or the level of achievement of program outcomes as of the end of that current term. The feedback loop is "closed" when the next instructor reads the prior assessment report, and "signs-on" to the improvement actions. The instructor sign-on, introduced in 2003-2004, is a key mechanism to propagate the knowledge learned by one instructor forward to the next instructor.

The results of all the course outcome assessments are integrated and fed into the outer ("global") feedback loop, along with additional data from senior exit surveys, alumni surveys, and industry board of advisors (BOA). The data are analyzed by the respective Assessment Committees with input from the Undergraduate Committee. Thus, specific recommendations for improvement are generated for faculty review. Note the key constituencies in this process include faculty, students, alumni, and industry. The program faculty review occurs at least once every year, typically in early fall quarter. At the faculty review meeting, the recommendations made by Assessment Committee are discussed and voted on. If approved by the faculty, specific improvement actions are assigned by the Chair to the relevant faculty committees for implementation, thus closing the feedback loop for the assessment, evaluation, and improvement process.

3.4 Relation of Course Content and Grades to Outcomes

The purpose of this section is provide "evidence that documents the relation of specific course content and grades to program outcomes," also to identify, for each outcome, a key course or set of course where that outcome is expected to be achieved and assessed.

For each course, the instructors' opinion of relevance each of its objectives to each of the a-k outcomes is given by its course matrix. Course matrices may have some rows/or and some columns that are all zeros. But every course has some relevance to some outcomes.

The key courses for a given outcome are such that the work done in those courses completely cover that outcome, and the scores on that work constitute an assessment of that outcome. The key courses for each outcome are given by its column in the following table.

key-course\outcome	a	b	c	d	e	f	g	h	i	j	k
EE 175AB & CS S179	X	X	X		X	X		X		X	
CS/EE 120AB				X							X
CS 161L											X
Engineering 180							X		X		
EE 100A	X										
EE 01AB	X										
CS 141	X										

3.4.1 Outcomes b, d, f, and j

b. an ability to design and conduct experiments, as well as to analyze and interpret data

d. an ability to function on multi-disciplinary teams

f. an understanding of professional and ethical responsibility

j. a knowledge of contemporary issues

For assessing outcomes b, d, f, and j, Computer Engineering has adopted the process established by Electrical Engineering to remedy its Criterion 3 weakness that was noted in EAC's Draft Statement of 2007. As quoted above, EAC's Final Statement of 2007 deemed that solution, described in EE's due-process response (below), to fulfill ABET's Criterion-3 requirements relative to outcomes b, d, f, and j.

EE's due-process response regarding Criterion 3:

> *While outcomes b, f, h, and j have been part of the material taught in the two quarter Senior Design project, EE175a,b, the demonstration of these outcomes was not well documented. The syllabus of EE175a,b has been rewritten so that these outcomes are explicitly included with corresponding assignments that will be documented and used to measure the students' performance in obtaining these outcomes. The revised syllabus explicitly showing the assignments associated with these outcomes is shown in Appendix A. The final report template with required sections related to these areas is shown in Appendix B. Starting this Winter and Spring quarters [2007-08], items b, f, h, and j will be documented for all EE students in either the EE175 final report, exam, or essay assignment. These instruments will be used to measure the program outcomes.*
>
> *Outcome d, an ability to function on multi-disciplinary teams, is being addressed in the two cross-listed courses EE/CS 120A/B. All Electrical Engineering, Computer Engineering, and Computer Science students are required to take this sequence of courses. It was decided that for both EE/CS 120A and 120B, lab partners will be*

> *rotated weekly until every student in the class has worked on one interdisciplinary team. The lab assignments from the interdisciplinary teams will be an instrument for demonstrating and measuring the students' ability to function on interdisciplinary teams. The revised catalog text for the courses is shown in Appendix C, and the revised syllabus for 120A is shown in Appendix D.*

Implementation by CE of EE's due-process remedies for b, d, f, and j. All Computer Engineering majors, like their Electrical Engineering peers, must take EE/CS 120AB, which establishes and assesses outcome d, as described above in EE's due-process response.

Similarly, all Computer Engineering majors must either take EE 175AB, which establishes and assesses outcomes b, f, and j as described above in EE's due-process response, or they must take CS 179, which has been updated via the same revisions described above for EE 175AB to achieve and assess outcomes b, f, and j.

Appendices F, G, H, and I of this document correspond to Appendices A, B, C, and D, respectively, of EE's due-dilligence response. They contain the revised course descriptions for EE 175 AB (and now CS 179), the final-report template for EE 175AB (and now CS 179), the Catalog description for CS/EE 120AB, and the syllabus for CS/EE 120A, respectively.

3.4.2 Outcomes c and h

c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

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

Following the process adopted for achievement and assessment of outcomes b, f, j, and d, both EE 175AB and CS 179 teach about outcome-c's constraints and outcome-h's impacts. Item #5 of the common syllabus for capstone design projects requires students to address those constraints and impacts in their capstone design projects — and each team's performance is given a score:

> 5. Global, economic, environmental and societal impact (2.5% of final grade): Each student must write an essay (800 or more words) providing an analysis of the potential global, economic, societal, and environmental impact of the project. You do not need to address every aspect, just focus on a couple of aspects that are related to your project. For example, if your project is made into a product, how will it improve quality of life, affect the environment, enhance entertainment, education, globalization etc.? Are there any ethical or political debates, laws and regulations related to your project?

Section 3 of the final-report template for CS 179 and EE 175AB (Appendix B) requires students to address both the constraints mentioned in outcome c (see Design Consideration 3.2) and the impacts mentioned in outcome h (see Design Consideration 3.11). That work is an identifiable component of the course grade.

3.4.3 Outcome g

Outcome g, "an ability to communicate effectively," is assessed via final grades in the required course Engineering 180, whose purpose is to teach effective communication, as described in the UCR Catalog:

> ENGR 180. Technical Communications (3) Lecture, 2 hours; workshop, 3 hours. Prerequisite(s): ENGL 001C or ENGL 01SC; upper-division standing. Develops oral, written, and graphical communication skills. Involves extensive oral communication and presentations in small groups, and preparing and critiquing reports, proposals, instructions, and business correspondence. Emphasizes professional and ethical responsibilities and the need to stay current on technology and its global impact on economics, society, and the environment.

The students are required to submit several papers and make a number of presentations during the term. Their grade for this course is based on the degree to which they have demonstrated their ability to communicate effectively.

(Note that Engineering 180 is prerequisite to the capstone project courses, EE 175AB and CS 179, in which students are required to make further presentations and to generate further reports.)

3.4.4 Outcome i

Outcome i, "a recognition of the need for, and an ability to engage in life-long learning," is assessed via the following questions on the Computer Engineering portion of the College's annual alumni survey.

- ```
  In the past year, have you attended any workshops,
  conferences, symposia related to your profession?
  [ ] yes
  [ ] no
  If so, roughly how many?  __________
  ```
- ```
  In the past year, have you taken any classes/courses
  related to your profession?
  [ ] yes
  [ ] no
  If so, roughly how many?  __________
  ```
- ```
  In the past year, have you read any books related to
  your profession?
  ```
  ```

```
[ ] yes
[ ] no
If so, roughly how many?  __________
```

- ```
  Do you subscribe to any periodicals related to your
  profession?
  [ ] yes
  [ ] no
  If so, roughly how many?  __________
  ```

See table 2 for results.

Outcome i is achieved through the historical context that faculty give their subject matter. In every course dealing with digital electronics (CS/EE 120AB) and/or computer architecture (CS 61, CS 161, and CS 161L) the context is one of rapid change, driven by Moore's-law phenomena, that requires people in the profession to learn new paradigms and new tools.

The same is true of the non-theory upper-division CS courses, but in a less direct way. For example, in the operating-system course, CS 153 it is noted that due to the effects of Moore's law (which are discussed in courses on machine organization CS 61, digital design CS/EE 120AB, and architecture CS 161), most future non-embedded computers will have multiple processors. But, to take advantage of that increase in computing power requires new programming techniques, e.g. multi-threaded programming, which requires additional learning by the current generation of computing professionals, including computer engineers. Similar things could be said for the courses on compilers, databases, embedded systems, programming languages, graphics, architecture, digital design, etc.

Emphasizing outcome i is explicitly mandated in catalog description of Engineering 180 (above):[3] "Emphasizes professional and ethical responsibilities and *the need to stay current on technology and its global impact on economics, society, and the environment*."

Outcome i is an anomaly in that we do not directly assess it via student performance on items and instruments administered in their courses. We do, however, survey the students at the end of each course asking their opinion of the degree to the course achieved each of its objectives and each of the program outcomes, including outcome i, and we do that again at the senior exit survey, where for 2007 both CS and CE were number one in their respective comparison groups:[4]

Outcome i	2002	2003	2004	2005	2006	2007
Comp Engr	NA	NA	5.45	5.17	6.07	5.95
Comp Sci	4.95	4.62	5.51	5.18	5.54	5.79

[3] In fact, Engineering 180's catalog description is intended to mandate the instructors cover outcomes f, g, h, i, and j. But the only outcome that Engineering grades on is outcome g. It is left for the capstone design courses to assess the outcomes f, h, and j. The assessment of outcome i is described in the next paragraph.

[4] As mentioned in Appendix J on page 65, the items on the exit survey are on a seven-point Likert scale.
  ```

But the direct assessment of outcome i comes from the alumni survey, which asks the four direct questions cited above — see questions 24-27 of Table 2, which starts on page 6.

3.4.5 Outcome a

Outcome a is "an ability to apply knowledge of mathematics, science, and engineering."

- **Continuous mathematics.** Students' achievement of an ability apply a knowledge of continuous mathematics, taught in Math 46, is assessed by their scores on selected instruments and items administered in the required courses EE 001AB (Engineering Circuit Analysis) particularly on assignments involving the use of calculus, differential equations, and Laplace and Fourier analysis:

  > EE 001A. Engineering Circuit Analysis I (3) Lecture, 3 hours. Prerequisite(s): MATH 046, PHYS 040C (both may be taken concurrently); concurrent enrollment in EE 01LA. Ohm's law and Kirchoff's laws; nodal and loop analysis; analysis of linear circuits; network theorems; transients in RLC circuits. Application of SPICE to circuit analysis.
  >
  > EE 001B. Engineering Circuit Analysis II (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): EE 001A and EE 01LA. Sinusoidal steady state analysis, polyphase circuits, magnetically coupled networks, frequency characteristics, Laplace and Fourier transforms, Laplace and Fourier analysis. Application of SPICE to complicated circuit analysis.

  The exams, labs, and homework in EE 1AB necessarily involve the application of calculus and differential equations, which are taught in EE 1AB's prerequisite course, Math 46.

- **Discrete mathematics.** Students' achievement of an ability apply a knowledge of discrete mathematics, taught in CS/Math 111, is assessed by their scores on selected instruments and items administered in the required course CS 141 (Design and Analysis of Algorithms), particularly on assignments in the analysis of algorithms involving graph theory and other parts of finite combinatorics.

  > CS 141. Intermediate Data Structures and Algorithms (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): CS 014 with a grade of "C-" or better; CS 111/MATH 111; MATH 009C or MATH 09HC; proficiency in C++. Explores basic algorithm analysis using asymptotic notations, summation and recurrence relations, and algorithms and data structures for discrete structures including trees, strings, and graphs. Also covers general algorithm design techniques including "divide-and-conquer," the

> greedy method, and dynamic programming. Homework and programming assignments integrate knowledge of data structures, algorithms, and programming.

The exams, labs, and homework in CS 141 necessarily involve the application of graph theory and other aspects of combinatorial mathematics, which are taught in its prerequisite courses CS/Math 111.

- **Science.** Students' achievement of an ability apply a knowledge of science is assessed by their scores on selected instruments and items administered in the required course EE 100A, particularly the exams, labs, and homework involving solid-state devices, which necessarily require an the application of knowledge and techniques from electricity and magnetism, which is taught in Physics 40C, an indirect prerequisite to EE 100A:

  > EE 100A. Electronic Circuits (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): EE 001B. Electronic systems, linear circuits, operational amplifiers, diodes, nonlinear circuit applications, junction and metal-oxide-semiconductor field-effect transistors, bipolar junction transistors, MOS and bipolar digital circuits. Laboratory experiments are performed in the subject areas and SPICE simulation is used.

- **Engineering.** Students' achievement of an ability to apply their knowledge of engineering is assessed via their grades in their capstone design course (EE 175AB or CS 179 – see Appendices A and B), which are based on their performance at identifying, formulating, and solving an engineering design problem by applying their knowledge of engineering.

3.4.6 Outcome e

Outcome e is "an ability to identify, formulate, and solve engineering problems."

Students' achievement of outcome e is assessed via their grades in their capstone design course (EE 175AB or CS 179 – see Appendices A and B), which are based on their performance at identifying, formulating, and solving an engineering design problem by applying their knowledge of engineering.

3.4.7 Outcome k

Outcome k is "an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice."

Students' achievement of outcome k is assessed via their grades in CS 161L:

> CS 161L. Laboratory in Design and Architecture of Computer Systems (2) Lecture, 1 hour; laboratory, 3 hours. Prerequisite(s): CS 120B/EE 120B; concurrent enrollment in CS 161. **Students design and simulate a complete computer system, using hardware**

> **description language and simulator.** Topics include instruction set architecture design, assemblers, datapath and control unit design, arithmetic and logic unit, memory and input/output (I/O) systems, and integration of all parts into a working computer system.

Also, via their scores in the laboratory portion of CS/EE 120B:

> CS 120B. Introduction to Embedded Systems (5) Lecture, 3 hours; laboratory, 6 hours. Prerequisite(s): CS 120A/EE 120A. Introduction to hardware and software design of digital computing systems embedded in electronic devices (such as digital cameras or portable video games). Topics include custom and programmable processor design, standard peripherals, memories, interfacing, and hardware/software tradeoffs. **Laboratory involves use of synthesis tools, programmable logic, and microcontrollers and development of working embedded systems.** Cross-listed with EE 120B.

3.5 Assessment-Driven Program Improvements

The purpose of this section is to "provide evidence that the results of assessment have been used to improve the program."

3.5.1 Expanding Discrete-Mathematics Prerequisite for CS 141

During the academic year 2002-03, many students, both CE majors and CS majors, did poorly in the required course CS 141, Design and Analysis of Algorithms, because of difficulties in their ability to apply discrete mathematics.

> CS 141. Intermediate Data Structures and Algorithms (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): CS 014 with a grade of "C-" or better; CS 111/MATH 111; MATH 009C or MATH 09HC; proficiency in C++. Explores basic algorithm analysis using asymptotic notations, summation and recurrence relations, and algorithms and data structures for discrete structures including trees, strings, and graphs. Also covers general algorithm design techniques including 'divide-and-conquer," the greedy method, and dynamic programming. Homework and programming assignments integrate knowledge of data structures, algorithms, and programming.

Moreover, the 2002 graduates of both programs (who were lumped together as CS) gave our program the rather low score of 4.85 out of seven on their exit surveys on item Q45: *"To what degree did your engineering education enhance your ability to: Apply knowledge of mathematics,"* which is the mathematics portion of outcome "a."

To remedy that situation, the discrete-mathematics prerequisite to CS 141 was expanded to a sequence of two courses, CS/Math 11 and CS/Math 111:

> CS 011. Introduction to Discrete Structures (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): MATH 009A or MATH 09HA; CS 010 or MATH 009B or MATH 09HB. Introduction to basic concepts of discrete mathematics with emphasis on applications to computer science. Topics include prepositional and predicate calculi, elementary set theory, functions, relations, proof techniques, elements of number theory, enumeration, and discrete probability. Cross-listed with MATH 011.

> CS 111. Discrete Structures (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): CS 010; CS 011/MATH 011; MATH 009C or MATH 09HC. Study of discrete mathematical structures with emphasis on applications to computer science. Topics include asymptotic notation, generating functions, recurrence equations, elements of graph theory, trees, algebraic structures, and number theory. Cross-listed with MATH 111.

The proposals for this change were submitted in December 2003, and the courses were first offered during the 2004-05 academic year.

The passing rate for CS 141 improved, as did the Q45-scores on on the exit survey:

Q45	2002	2003	2004	2005	2006	2007
Comp Engr	NA	NA	5.09	6.17	6.07	5.58
Comp Sci	4.85	5.29	5.18	5.32	5.39	5.74

Here is a table of the before-and-after grade distributions.

CS 141	2002-03	2005-06
A+	3	1
A	6	9
A-	2	10
B+	4	3
B	2	1
B-	2	1
C+	4	0
C	3	0
C-	7	2
D+	2	0
D	2	0
D-	1	0
F	15	2
NC	1	0
W	2	1
Sum	56	19

Appendix L.1 on page 71 gives the anonymized individual grades plus the course proposals for CS/Math 11 and CS/Math 111.

3.5.2 Upgrading Computing Resources

The results of our graduating-seniors' exit surveys are reported and discussed at departmental meetings and/or retreats. Factor 5 on those reports is "Computing Resources," and, for Computer Engineering majors skill in the use of computers is a major component of outcome k.

In 2003 , with respect to Q25 of the exit survey, *"satisfaction with: Availability of computers in the Engineering School,"* on a seven-point scale, we ranked 1.64 below the mean of our selected comparison class, .94 below the Carnegie Class, and .79 below the mean of all institutions. Out of 70 questions on that year's survey, Q25 was our fifth worst item in term of deviation from the mean.

As a result, the CS&E Department undertook an initiative to establish a $20 per course "course-materials" fee and with that predictable flow of funding to establish a schedule for periodic upgrades of the equipment in its instructional laboratories.[5]

The first round of upgrades took place during the 2005-06 academic year, and our exit-survey scores on EBI's Factor 5 showed a predictable rise:

Factor 5	2002	2003	2004	2005	2006	2007
Comp Engr	NA	NA	4.27	5.17	6.21	5.17
Comp Sci	4.75	4.75	5.05	4.75	5.17	5.65

There was a correlated improvement in the exit-survey results for outcome k.

Outcome k	2002	2003	2004	2005	2006	2007
Comp Engr	NA	NA	5.17	5.33	6.14	5.53
Comp Sci	4.70	4.72	5.00	4.75	5.14	5.44

Electrical Engineering followed suit a year later, and now both departments have their in-lab instructional computing equipment on a three-year replacement cycle.

3.5.3 Emphasizing Use of Debuggers in CS 10, CS 12, and CS 14

The campus's introductory programming series is CS 10, CS 12, and CS 14, which extends over three quarters. CS 14 is the final programming course before the upper-division, where students are expected to handle such term projects that involve implementing small compilers, file systems, etc.[6]

[5] This was not the first time that idea was discussed, but the results of assessment, specifically the results of the exit surveys, provided the impetus, the urgency, and the insitutional leverage to make it happen.

Appendix L.2 on page 83 contains intitutional documents proposing the materials fee, approving it, specifying exactly how it can be used, etc.

[6] The objectives and the course matrix for CS 14 are shown in Appendix K on page 69.

At the end of Winter Quarter 2007, based his end-of-term assessment of the programming-assignments component in CS 14 and subsequent conversations with his teaching assistant, the instructor for CS 14, Kris Miller, was concerned that too many students had not acqured an appropriate level of programming skill. In particular, he and the teaching assistant felt that it was taking many students an inordinate amount of time to accomplish their programming assignments. It should be noted that this was his first time teaching this course, and the same was true of his teaching assistant.

He discussed those concerns at the next weekly meeting of CS&E's Committee on Instruction, where it was felt that a greater emphasis should be placed on the use of software-development tools, because:

- The use of tools would to some extent encourage better methodology and develop better skills.
- The use of tools would save labor, thus helping students complete their assignments more quickly.
- The use of debuggers, in particular, would give students a better ability to visualize what is happening inside a computer as it runs a program.
- For computer scientists and engineers, programming skills and skill in the use of software-development tools is a component of outcome k: *"an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice."*

Below is a summary of Kris Miller's notes from six months later, after emphasizing the use of debuggers in CS 14:

> We decided to be more proactive in teaching the students to use debuggers. We had always lectured on it and shown them in lecture how to use gdb, but we never required students to use it on their own. Many students were spending too much time completing our assignments and it was obvious when meeting with these students during office hours and in lab that they needed more help with their debugging skills. The difficulty the students where having was also evidenced by their scores on the gradebook.
>
> So, two quarters ago [Spring 2007], we added labs to CS 12 and CS 14 where the TAs demonstrated the debugger, gdb, using video projectors in the lab and then had the students debug code that we gave them using gdb. Some of the students would then go on and use them on their own after this, but we found that the majority did not. So, this past quarter [Fall 2007], we wrote a tutorial on ddd (a gui version of gdb) that we will provide to all students in CS 10 and 12 this coming quarter [Winter 2008]. We will include this tutorial in the CS 10 lab in week 5. In CS 12, we will keep the lab we already have on debugging, but also provide the tutorial to the students for reference.

> More importantly, though, in CS 12 and starting with lab 5 in CS 10, we will have the students demonstrate their finished lab exercises to their TA every week using the debugger. They were already demonstrating their finished exercises each week to get points for the lab, but now they will have to run the program through the debugger, using different gdb commands that we decide are appropriate for that exercise and are commands we think they need more practice with. This will ensure the students continue to use the debuggers and hopefully become comfortable enough with them that they start using them on their own with their programming assignments.

Per-student scores on their programming assignments for Winter 2007, Spring 2007, Fall 2007, and Winter 2008 can be found in Appendix L.3 starting on page 95. It should be noted that all of these scores are from the same instructor and teaching assistant.

3.5.4 Requiring a Technical-Communications Course

Based on an analysis of student exit surveys, feedback from employers of our students (especially, employers who are members of our Board of Advisors), and evidence from student grades particularly in their capstone design course, it was noted in 2003 that many of our students had weaknesses in oral and written communication.

The faculty unanimously decided to integrate oral and written communication into every offering — see below. As a concrete example, consider CS 122B. Originally students were required to write three short independent reports. The shortness of the report meant that many students abandoned any attempt at a narrative, and instead produced little more than a list of bullet points. It was decided to replace this with a single larger report. Students were clearly briefed on the faculty expectation that the report should be a high quality "stand-alone" document, with a clear structure abstract, introduction, motivation etc.

In the Fall of 2004, on advice from the Boards of Advisors of both departments and rather low scores for both oral and written communication on the exit surveys, we established a course on Technical Communications, Engineering 180, which was first offered in the Summer of 2005.

> ENGR 180. Technical Communications (3) Lecture, 2 hours; workshop, 3 hours. Prerequisite(s): ENGL 001C or ENGL 01SC; upper-division standing. Develops oral, written, and graphical communication skills. Involves extensive oral communication and presentations in small groups, and preparing and critiquing reports, proposals, instructions, and business correspondence. Emphasizes professional and ethical responsibilities and **the need to stay current on technology and its global impact on economics, society, and the environment. [Emphasis added.]**

We have made Engineering 180 a requirement for the BS degrees in CS, CE, and EE. We also made it a prerequisite to the capstone design courses, EE 175AB and CS 179, and the instructors for those capstone courses have noted a significant improvement in the students' communication skills as a result of that curricular change.

The exit surveys contain two items related to outcome g, Q58 and Q59, which ask "To what degree did your engineering education enhance your ability to: Communicate using [oral/written] progress reports". Here is the longitudinal survey data, showing both the initial weakness and the long-term improvement relative to outcome g:

Q58 oral comm.	2002	2003	2004	2005	2006	2007
Comp Engr	NA	NA	5.27	4.17	5.50	4.89
Comp Sci	3.41	4.08	4.41	4.50	4.97	5.00

Q59 written comm.	2002	2003	2004	2005	2006	2007
Comp Engr	NA	NA	5.20	5.17	5.86	5.16
Comp Sci	3.94	4.43	5.22	5.25	5.24	5.54

3.6 Implementation of Additional Assessment Tools

The purpose of this section is to provide evidence documenting implementation of additional assessment tools identified in the Self-Study and referred to in the due-process response.

EAC's Final Statement says of CE's due-process response that:

> The [due-process] documentation also identified additional assessment planned in the future.

and that:

> In preparation for the review, the EAC anticipates [...] evidence documenting implementation of additional assessment tools identified in the due-process response [...]

What the due-process response said about additional assessments was:

> In addition, we are experimenting with new ways to assess outcomes. As the Self-Study pointed out, and the reviewer mentioned in the Draft Finding for Criterion 3, we implemented a new survey with the entering freshman class in Fall 2006. This survey was designed to measure expectations at the beginning of the freshman year, and a second survey the following Fall is designed to measure the extent to which the actual experience matched the expectations. We will complete the first cycle of this assessment process in Fall 2007.

This was prompted by this from EAC's Draft Statement:

> It is stated in the report that the college will administer a new assessment tool in fall of 2006 but the process used presently in measurement of program outcomes is not documented.

Specifically, the "Additional Assessments" section of CE's Self-Study mentioned three anticipated additional assessment mechanisms. Two of the three, UCUES and SAIS, have been implemented and are being deployed as systemwide and campuswide services, respectively; links to their homepages are provided below. The third of the three has been suspended by the College of Engineering, but its resumption is under consideration.

3.6.1 The UC Undergraduate Experience Survey (UCUES)

From the "Additional Assessments" section of CE's self-study:

> The College and the campus also perform assessments to evaluate student expectations and performance. At the campus level, the most significant assessment tool is the UC Undergraduate Experience Survey, or UCUES. This is a uniform questionnaire, which is administered at all UC campuses. Each campus also is able to add its own questions. The questionnaire is administered every two years, although there is some discussion of converting to an annual format. While UCUES does not enable us to compare our student responses directly with those of non-UC campuses, it does provide a basis for comparison with all of the other UCs with undergraduate programs (note that UC San Francisco has no undergraduate programs).

Per the UCUES homepage:[7]

> The University of California Undergraduate Experience Survey (UCUES) solicits student opinions on all aspects of the UC experience.
>
> UCUES content is broad and covers most aspects of students' academic and co-curricular experience. Students evaluate such things as instruction, advising and student services.
>
> UCUES also provides information about student behaviors — their study habits and how they use their time. The survey is also a way of documenting student attitudes, self-perceptions and goals.
>
> Finally, UCUES provides demographic information not available through other data sources.

The UCR campus is now a participant in UCUES, and we have obtained data aggregated at the college level but, so far, not at the program level. Our Dean's Office is working to expedite the delivery of that per-program information. It is likely to be helpful in improving our process for achieving program outcomes but possibly not in assessing the degree to which those outcomes are achieved.

[7] http://www.universityofcalifornia.edu/studentsurvey/

3.6.2 College of Engineering Freshman Surveys

From the "Additional Assessments" section of CE's self study:

> The Bourns College of Engineering will begin to administer a new assessment tool in the fall of 2006. All incoming freshmen will receive a questionnaire designed to explore their expectations. In the fall, a second questionnaire will examine how well the actual experience matched the expectations.

After being administered in the Fall of 2006 this program was suspended for Fall 2007 on the belief that the campuswide UCUES system (discussed above) would supersede it. However, difficulties in getting access to the UCUES data on a per-program basis has BCoE administrators considering restarting this program for Fall 2008. In any case, it is not clear that freshman expectations are particularly relevant to the assessment of CE's program outcomes, which have to do with what students actually know and can do on graduation day.

3.6.3 The Student Academic Information System, SAIS

From the "Additional Assessments" section of CE's self study:

> The campus has developed a single relational database (200 fields) to answer queries on student performance and trends, with longitudinal information. There is tiered access to different levels of detail; this protects the privacy of the students for whom data are gathered. As the database is populated with new information, it should be a valuable resource for providing information on the performance of engineering students in non-engineering courses and for evaluating their overall experiences.

This system has been implemented and recently deployed by the Campus, and is known as the SAIS.[8]

> The Student Academic Information Systems (SAIS) are a collection of web-based programs that facilitate access to student information for the purposes of advising, mentoring, statistics, and a variety of other applications.

Our Dean's Office is in the process of granting access to individual faculty members to a subsystem of SAIS, the Student Data Query System (SDQS)[9]

> The Student Data Query System is part of a collection of applications, web reports, and online databases known as the Student Academic Information System (SAIS).
>
> The SDQS was developed for departmental and college personnel, faculty, and staff directly involved in student academic advising.

[8] http://www.cnc.ucr.edu/saisdev/
[9] http://www.cnc.ucr.edu/sais/index.php?content=sdqs

> The SDQS contains a secure, intuitive web interface that provides access to pre-defined reports as well as a query tool enabling users to report on wide variety of academic information (e.g. cumulative GPA, academic holds, units earned, enrollments, etc.). Individuals that have responsibility for advising students (e.g. who need to run a list of their advisees who are in academic difficulty) or reporting (i.e., who need to know how many students are enrolled for a particular major and create classes to meet the demand) will find the SDQS highly valuable.

SDQS will be available for use in this year's assessments and will give the Assessment Committees of the various programs online access to each student's current transcript, plus some level of information aggregation. It's expected that access to students' grades in their courses outside their major can be helpful in improving the achievement and assessment of the soft outcomes.

SAIS/SDQS should significantly enhance the institutional-data input (i.e., the eighth input) of CE's outcomes-assessment system by making that data more timely and more tailored to our needs. This data comes from the campus's Office of Academic Planning and Budget and should provide on-demand access to per-program statics like enrollments, aggregated demographic information (e.g., ethnicity and family income), retention rates, time-to-graduation statistics, average GPAs by cohort, etc. We already get some of that data as occasional printouts, but not necessarily when we want it and aggregated in a convenient way, e.g., data is often aggregated by department or by course rather than by program.

Appendix A: The Old Program Educational Objectives

…this vision of the Computer Engineering program lead us to define the following Program Educational Objectives (PEOs):

- *Provide a well-rounded and balanced education through required studies in elected areas of the humanities and social sciences.*
- *Provide the broad fundamental training in the areas of engineering, mathematics, science, and statistics that will serve as the foundation on which the students' subsequent CE training will be built.*
- *Cover in sufficient depth those fundamental areas required for CE students to understand, design, and use computers and the engineered systems that contain computers.*
- *Provide extensive, relevant laboratory and hands-on experience to strengthen understanding of scientific, logical, statistical and engineering principles.*
- *Integrate the use, design, and interfacing of computers throughout the undergraduate CE program.*
- *Emphasize both oral and written communication throughout the CE curriculum.*
- *Teach students to apply theoretical knowledge to design problems common to modern computer engineering practice, using structured design methodologies and state-of-the-art tools.*
- *Allow students the freedom to mold their programs of professional specialty studies by allowing each student to choose from a broad array of technical electives.*
- *Maintain a schedule of course offerings allowing timely completion of degrees.*
- *Ensure the high-quality undergraduate education necessary for a student to progress to the MS and PhD degree level or succeed in an industrial career.*

Appendix B: Part I

Agenda, and Attendance Roster at the Board of Advisors Meeting held on 11/8/07

University of California Riverside
Department of Computer Science & Engineering

CSE 2007 Board of Advisors Meeting

Thursday, November 8, 2007

Board Meeting Agenda
(Subject to change)

8:30 – 9:00 a.m.	**Check- In / Continental Breakfast: Engineering II, Room 205/206**
9:00 – 9:15 a.m.	**Welcome and Introduction**
9:15 – 9:45 a.m.	**Presentation of the Bourns College of Engineering** Reza Abbaschian, BCOE Dean
9:45 – 10:30 a.m.	**Presentation of the State of the Department of Computer Science & Engineering:** Laxmi Bhuyan, Chairman
10:30 – 10:45 a.m.	**Morning Break**
10:45 – 11:15 am	**Introduction of Sponsors**
11:15 – 12:00	**Industry Participation on furthering Graduate Education and Research, Funding and Departmental Outreach** Michael Campbell, Chair Advisory Committee Richard Chute, Assistant Dean, College of Engineering
12:00 – 1:00 p.m.	**Lunch Buffet on Engineering II patio**
1:00 – 1:30 p.m.	**Undergraduate Programs and ABET:** Neal Young and Eamonn Keogh
1:30 – 2:00 p.m.	**Graduate Programs: Walid Najjar**
2:00 – 2:30 p.m.	**Current Research Projects** Michalis Faloutsos, Chair Research Committee
2:30 – 3:45 p.m.	**Break/Poster presentation**
3:45 – 4:30 pm	**Keynote Address by Raj Yavatkar, Intel Fellow**
4:30 – 5:00 p.m.	**Conclusion and Future plan**
5:00 p.m.	**Reception**

MARLAN AND ROSEMARY BOURNS COLLEGE OF ENGINEERING

CSE Advisory Board Meeting 2007
November 8, 2007
SIGN IN SHEET

NAME	COMPANY	SIGNATURE
Agrawal, Amit	Auryn, Inc.	
Balandin, Alexander	UCR	
Bhuyan, Laxmi	UCR	
Campbell, Michael	The Aerospace Corporation	
Cenci, Jacci	Silicon Graphics, Inc.	
Chrobak, Marek	UCR	
Chute, Richard	UCR	
Ciardo, Gianfranco	UCR	
Dumer, Ilya	UCR	
Faloutsos, Michalis	UCR	
Fleisch, Brett	UCR	
Guo, Zhi	Brocade Communications	
Gunopulos, Dimitrios	UCR	
Gupta, Rajiv	UCR	
Harrell, John	The Aerospace Corporation	
Hsieh, Harry	UCR	
Jiang, Tao	UCR	
Kalogeraki, Vana	UCR	
Keogh, Eamonn	UCR	
King, Steve	Intel Corporation	
Kinyon, Paul	Silicon Graphics, Inc.	
Krishnamurthy, Srikanth	UCR	
Lonardi, Stefano	UCR	
Matthews, Richard	Silicon Graphics, Inc.	
Mohanty, Satya	Cisco Systems, Inc.	
Molle, Mart	UCR	
Najjar, Walid	UCR	
Pinkston, Timothy	NSF	
Przymusinski, Theodor	UCR	
Ravishankar, Chinya	UCR	
Ray, Sibabrata	Google, Inc.	
Rolland, Erik	UCR AGSM	
Sandhu, Jay	ESRI	
Sarris, Anthony	Unisys Corporation	
Tan, Sheldon	UCR	
Tolbert, Douglas	~~Unisys Corporation~~ UCR	
Tsotras, Vassilis	UCR	
Vahid, Frank	UCR	
Wu, Jie	NSF	
Yavatkar, Raj	Intel Corporation	
Young, Neal	UCR	
Zhang, Xiao	Qualcomm	
Zhao, Li	Intel Corporation	
Zordan, Victor	UCR	
Abbaschian, Reza	Deans office/BE-Dean	
Hill, Victor	UCR	
Rayne, Tom	UCR	
Gonzales, Andrea	UCR	
Thomas, Bijoy	UCR	
Yavatkar, Raj	Intel	
Hearsink, Madie	UCR	
Phanhzrath, Terri	UCR	
Najjar, Walid	UCR	
Strother, Christina	UCR	

Appendix B: Part II

Minutes of Computer Science and Engineering Board of Advisors Meeting
11/8/07: ABET- Presentation Eamonn Keogh and Neal Young

Neal Young: Going over six technical electives/ requirements
Steve King: Use test passing as an indicator

Neal Young: UCR has software engineering as a hiring career
Tom Payne: UCR encourages students to test often. Testing often compilers

Ravi: Only a certain number of units they are forced to take, where do you fit it in?

Victor Zordan: Video course, larger number this time around hopefully

NY: Feedback about software engineering. Better at other universities

JH: Can't do it at undergraduate level
NY: Testing and working with clients take something out of core and put it in software engineering?

Tony Sarris: Talk about while process of systems/ software engineering. Need skill at front end and back end because they will not be as productive of software engineering.

MC: And they should take them in a good manner of timing.
NY: High level software engineering – like to see more

NY: Orientation to the career process – part of curriculum and capstone project

ABET Report to BOA – Eamonn Presentation
What is ABET? – Nonprofit

- Accreditation – unconditional six year pass/ 2 weaknesses
- Outer loop/ inner loop
- Described program educational objectives – Neal
- Proposed PEO's
- Discussion and Feedback of proposed PEO's

Appendix C: Computer Science and Engineering Faculty Meeting Minutes from November 14, 2007

Faculty Meeting Minutes from November 14, 2007

The meeting commenced at 12:00 p. m. by Chair Laxmi Bhuyan. The following faculty were present: Laxmi Bhuyan, Rajiv Gupta, Tao Jiang, Mart Molle, Walid Najjar, Chinya Ravishankar, Vassilis Tsotras, Michalis Faloutsos, Eamonn Keogh, Srikanth Krishnamurthy, Stefano Lonardi, Thomas Payne, Neal Young, Harry Hsieh, and Christian Shelton.

(A) Announcements were made by Laxmi regarding:

(1) The faculty meeting will be held every two weeks from 12-1 p. m.

(2) No corrections were suggested for the October 24th meeting minutes.

(3) Intel will be sending from $10,000-$20,000 to support the distinguished lecture series and their logo will appear on the series posters.

(4) Mike Carrey has been recommended by Reza for an Eminent Scholar position at UCR- Discussion took place as to where he is interested in applying for a position and what we can do to make an attractive offer to him. Mike will be back to Riverside December 7th for a visit.

(B) Eamonn presented the proposed ABET program educational objectives and their need to be measurable and explicit. Discussion ensued as to whether or not they should be published in the general catalogue. A vote was taken and nine faculty voted for the Program Educational Objectives as presented.

(C) Debate was held about the Advisory Board and what their role is in relation to the Department; their interest is in graduate and undergraduate programs. Laxmi suggested that perhaps there should not be an Advisory Board meeting every year. He stated that he had presented the agenda to faculty for feedback and received none. Perhaps the agenda should be different next year and change it to an Industry Day. Or perhaps have a separate Industry Day and keep the Board of Advisors for ABET purposes. It was suggested that if the department held an industry day there could be more research and poster presentations which would feature graduate student research. The population of the board of advisors was discussed and that most were high level managers. It was suggested that perhaps it would be better to target industry affiliates who are mid level managers and would be the managers of the people who would actually hire our students. The department could form a committee to update the list (which hasn't been reviewed and updated since 2001) by deleting old inactive names and inviting new people. Due to time constraints it was suggested that this discussion be continued at another meeting.

(D) Christian Shelton's merit was discussed and ballots were distributed for voting.

(E) Vassilis said it would be good to have 4:00 p. m. meetings on Fridays for students to meet with the faculty.

The meeting was adjourned at 1:40 p.m.

Appendix D: PEO Approval from Student Organizations

The PEOs were overwhelmingly approved by the IEEE student chapter on campus.

-------- Original Message --------
Subject: Re: Approval of EE PEOs
Date: Mon, 12 Mar 2007 21:00:10 -0700
From: David Keith <dckeith@gmail.com>
To: Amit K. Roy-Chowdhury <amitrc@ee.ucr.edu>
CC: Martin Gawecki <martin.gawecki@gmail.com>
References: <45EF2223.5060304@ee.ucr.edu>

Dear Dr. Roy-Chowdhury,

I brought up the EE Department PEOs at the IEEE General Meeting today and the estimated 50 IEEE members present voted to pass the PEOs as submitted. ……

Thank you,
David Keith
IEEE Chair 2006-07

On 3/7/07, **Amit K. Roy-Chowdhury** <amitrc@ee.ucr.edu> wrote:
Dear Martin/David, I am the chair of the ABET committee (accreditation program for EE) and I need to get the Program Educational Objectives (PEOs) approved by different constituencies. The EE faculty has approved the following PEOs. Could you please try to have them approved by the student body, especially those from EE? You may also give any comments for future changes. Please let me know when you can get this done.

Graduates of UCR's BS degree program in Electrical Engineering will meet high professional, ethical, and societal goals as demonstrated by:

success in *post-graduation studies as evidenced by*:

- satisfaction with the decision to further their education
- advanced degrees earned
- professional visibility (e.g., publications, presentations, patents, inventions, awards)
- professional responsibilities (e.g. professional mentoring, professional society membership and offices, reviewing and editorial work for professional journals)

success in *a chosen profession or vocation as evidenced by*:

- career satisfaction
- promotions/raises (e.g. Management leadership positions or distinguished technical positions)
- professional visibility (e.g., publications, presentations, patents, inventions, awards)
- professional responsibilities (e.g. professional registration, professional mentoring, professional society membership and offices)
- entrepreneurial activities
- consulting activities

contributions to society as evidenced by:

- Leadership roles
- Public service
- Mentoring / outreach activities
- Volunteer service

Thanks
Amit K. Roy-Chowdhury

Appendix E: Part I: Sample Consultation of Employers about CE PEOs

ISCA TECHNOLOGIES
Pest Management Tools & Solutions

A NIST, NIH, NSF, USDA and US Army research award recipient company

Tuesday, June 03, 2008

Department of Computer Science and Engineering
University of California Riverside
Riverside, CA 92521-0144

Attn: Laxmi N. Bhuyan, Professor and Chair
RE: Computer Science Educational Objectives

ISCA Technologies, Inc. (Riverside, CA) is a successful corporation that provides novel pest control strategies for agricultural and urban applications. It is our goal to provide integrated pest management solutions that are economical, effective, environmentally friendly, and most importantly do not have the harmful side effects of many conventional pest management techniques that rely solely on insecticides.

Our company employs several computer engineers for tasks as diverse as building intelligent devices which can recognize insects from wingbeat frequencies to building geospatial databases.

In the last five years, ISCA Technologies has hired several UCR CE and CS alumni for both long term and short term projects. We currently have one full time employee who is a UCR CE alumnus, Mr. John Cortes. As such, we are very interested in the quality of the program at UCR, and we are delighted to say that we have been consulted by them, formally and informally, many times over the last four years.

In late November of 2007, Dr. Eamonn Keogh visited us to ask our opinion of a new set of Program Educational Objectives for the CE program. We formed an ad-hoc committee to examine them and give feedback, and were gratified to see this feedback was taken into account.

Our business has benefited from its close proximity to a first class computer engineering department that is anxious to solicit feedback and continuously improve its program.

If we can be of any further assistance, please do not hesitate to contact us.

Sincerely,

(For Dr. Mafra-Neto, who was traveling this day)
ISCA Technologies, Inc.
Vice President
Reginald R. Coler, Ph.D., B.C.E.
Agenor Mafra-Neto, Ph.D.

ISCA TECHNOLOGIES, INC
2060 Chicago Avenue, Suite C2, Riverside, CA 92507, U.S.A.
www.iscatech.com Tel: (909) 686 5008 Fax: (815) 346 1722 E-mail: info@iscatech.com

Appendix E: Part II Sample Consultation of Employers about CE PEOs

```
Date: Mon, 16 Jun 2008 13:52:53 -0700
Message-ID: <627102C921CD9745B070C3B10CB8199B0A835730@hardwire.esri.com>
In-Reply-To: <4856C78F.1070405@cs.ucr.edu>
From: "Brenda Wolfe" <bwolfe@esri.com>
To: "Eamonn Keogh" <eamonn@cs.ucr.edu>
X-Virus-Scanned: ClamAV using ClamSMTP
```

To Whom It May Concern:

I, Brenda Wolfe, am a product manager for ESRI. ESRI designs and develops the world's leading geographic information system (GIS) technology. The company is made up of 2,500 employees in the U.S. alone, and is privately-held by the founders. In 2006, year revenues were more than $660 million.

Because of the physical closeness of our Redlands headquarters to UCR, and because of the high quality of UC students generally, ESRI employees many full time UCR alumni.

In early November of 2007, I was approached by a delegation from UCR, consisting of Dr. Eamonn Keogh and Dr. Tom Payne, to ask for feedback regarding the UCR students we had hired, and to gather feedback on a new set of program educational objectives for the UCR Computer Engineering program. As a product manager, I am constantly working with software developers and engineers, and I feel I am an idea person to provide such feedback.

In a sequence of meetings at UCR, I was extensively interviewed and debriefed. From my perspective, I learned a great deal about the program, and I believe that the Computer Engineering Department derived benefit from my input. I was told that this practice would happen at least annually, and I look forward to continuing to give input and being briefed on the process.

If I can be of any further help in this matter, please do not hesitate to contact me.

Sincerely, Brenda Wolfe

Brenda Wolfe | Product Manager

ESRI | 380 New York St | Redlands, California 92373

E-mail: bwolfe@esri.com | Phone: (909) 793-2853 ext. 3935

Appendix F: Part I Course Descriptions for EE-175 and CS 179

Course Description for EE-175

Bourns College of Engineering, University of California, Riverside

EE-175: Senior Design Project
Winter and Spring 2007

Class
Lecture: Mondays 10:10 a.m. - 11:00 a.m. STAT B650
Lab: to be arranged with section professor

Instructors:

Professor Amit Roy Chowdhury	amitrc@ee.ucr.edu	EBU-II 322 827-7886
Professor Yingbo Hua	yhua@ee.ucr.edu	EBU-II 432 827-2853
Professor Sakhrat Khizroev	khizroev@ee.ucr.edu	EBU-II 424 827-5816
Professor Ping Liang	liang@ee.ucr.edu	EBU-II 323 827-2261
Professor Mihri Ozkan	mihri@ee.ucr.edu	EBU-II 436 827-2900
Professor Sheldon Tan	stan@ee.ucr.edu	BU-II 424 827-5143

Prerequisites
Senior standing in Electrical Engineering.

Objectives
The Senior Design Project is the culmination of course work in the bachelor's degree program in electrical engineering or computer engineering. In this comprehensive two-quarter course, students are expected to apply the concepts and theories of electrical engineering or computer engineering to an engineering project. Detailed written reports, working demonstration, poster and oral presentations are required.

Credits and Hours
Eight quarter units of engineering design credit will be granted for the completed project and other required components listed here. It is expected that approximately twelve hours of laboratory (or field) work will be required weekly for satisfactory completion of the project. The design value of these units has been accounted for in the total number of required science and design units necessary for graduation.

Weekly Class Meetings
The entire class of EE 175A and EE 175B will meet once each week for one hour. These meetings are intended to provide instruction in topics common to all design projects (engineering economics, ethics, etc.). They may include brief presentations by each team, aimed at improving technical presentation skills. Lectures will be provided by the instructors and some outside contacts. These meetings are mandatory and are for your benefit (10% of grade). In addition, it is expected that each project team meet with their faculty supervisor on a weekly basis to report and discuss the progress of the project.

Project Participants
Projects will be completed in small teams with shared responsibility. If the team option is elected, each student will be held responsible for a distinct component of the total team effort. Team

projects will be sufficiently more complex than individual projects so as to allow for an appropriate workload for all team members.

Project Elements

The senior design projects will include proposal and report writing, experiment design, hardware and software design, test plan and test, broad impact and ethical issues, among other things. Remember that this is a design course and students must define a ***design*** project, not a research, nor an evaluation or fabrication project. It is a balanced approach to encompass many of the elements stated above.
Each design project must include the following components:

1. **A Clear Technical Design Objective and the Project Contract** (Contract due 1/22/07): Each group must identify a design project in the first two weeks of the Winter quarter, and should have good estimated answers to the following questions and obtain the endorsement of the section professor:
• Is the objective achievable within two quarters?
• Does the group have the expertise to complete the design, prototype, and testing?
• Does the group have access to the financing for the prototype?
• Does the group have access to the required test equipment?
• Is this a design problem (not research, nor fabrication)?
• Is the project significant enough to be worthy of eight credits (12 hours/week/person)?

2. **Experiment Design and Feasibility Study** (Due in week 5 to 6 of the Winter quarter, 5% of final grade)**:** Each group must write an Experiment Design document, which describes its design of experiments to evaluate the feasibility of its project ideas, alternatives, trade-offs and realistic engineering constraints. These experiments must then be carried out and experimental results are to be analyzed to prove the feasibility of your project idea and select the best solution to be further developed in the design project. The experimental data, the quantitative analysis of the data, and the conclusion are to be presented in a Feasibility Study Report.

3. **A Detailed Design Specification** (Due in week 7 to 9 in the Fall quarter, 10% of final grade): Describes the functions and quantitatively measurable design objectives, design methods, hardware and software architecture and interfaces, user interface, realistic constraints in terms of time, cost, safety, reliability, social impact, ethics, etc. It must also list and consider the industry standards related to your project, including hardware, protocols, software and tools (e.g., 802.11, RS232, USB, PCI, 3G, API, device drivers, VHDL).

4. **Test Plan** (Due in week 8 to 9 of the Fall quarter, 5% of final grade)**:** A detailed description of your design of experiments to test and measure whether the final product and each of its components meet the design specifications, and, if not, to test and measure the errors and deviations from specifications.

5. **Global, economic, environmental and societal impact** (Due 2/12/07, 2.5% of final grade): Each student must write an essay (800 or more words) providing an analysis of the potential global, economic, societal, and environmental impact of the project. You do not need to address every aspect, just focus on a couple of aspects that are related to your project. For example, if your project is made into a product, how will it improve quality of life, affect the environment, enhance entertainment, education, globalization etc.? Are there any ethical or political debates, laws and regulations that are related to your project?

6. Contemporary Engineering issues (Due 2/26/07, 2.5% of final grade) Provide in essay form a description of the contemporary engineering issues related to the project. Potential contemporary engineering issues related to your project are new technologies, new industry standards, new design methods, new materials, new trends in manufacturing, etc.

7. **Detailed Quantitative Design and Prototype** (To be completed before week 9 of the Spring Quarter) Each component of the selected solution and the overall system should be designed and implemented. In most cases, it is necessary to construct a system prototype (or component prototype).

8. **Test Report** (Due week 10 of the Spring quarter, 5% of final grade): Carry out the Test Plan you developed to how well your final design meet the specifications under the defined constraints, and present the results in this report.

9. **Poster and Final Presentation** (Due week 10 of the Spring quarter, 15% of final grade): Each group must prepare a poster and a Power Point presentation, and present the final design to faculty and other students.

10. **Working Demo and Final Report** (Due 6/8/2007 before 5pm, 40% of final grade): The final report must include all the required sections and appendices in a template file to be posted on the iLearn website for the course. A working demo of the completed design is critical, it is a convincing evidence that you design is completed and works. The demo should show whether and how design specifications are met.

Grading
In addition to the 9 deliverables listed above, each project will also be graded on the following:

1. **Laboratory Notebook, Weekly Reports and Lecture Attendance—**The student teams will need to maintain a laboratory notebook for the duration of their projects and submit written weekly reports. This notebook and reports will be inspected at weekly meetings and graded for content. Attendance of the lectures is mandatory. Everyone must sign in at each lecture. (This portion accounts for 10% of grade)

2. **Ethics Exam**: 5% of the final grade
Grading will be determined by all of the section professors conferring on each project

Appendix F: Part II Course Descriptions for EE-175 and CS 179

Course Description for CS 179

CS 179E. Compilers (4) Discussion, 1 hour; laboratory,9 hours. Prerequisite(s): CS 141 and CS 152 with grades of "C-" or better; ENGR 180; 8 additional upper-division units in Computer Science. Student teams plan, design, implement, test, and document a Compiler-related system using techniques from previous related courses. Requires a written report and an oral presentation. Emphasizes professional and ethical responsibilities and the need to stay current on technology and its global impact on economics, society, and the environment.

CS 179F. Operating Systems (4) Discussion, 1 hour; laboratory, 9 hours. Prerequisite(s): CS 153 with a grade of "C-" or better; ENGR 180; 8 additional upper-division units in Computer Science. CS 160 is recommended. Student teams plan, design, implement, test, and document an Operating Systems-related system using techniques from previous related courses. Requires a written report and an oral presentation. Emphasizes professional and ethical responsibilities and the need to stay current on technology and its global impact on economics, society, and the environment.

CS 179G. Database Systems (4) Discussion, 1 hour; laboratory, 9 hours. Prerequisite(s): CS 141 and CS 166 with grades of "C-" or better; ENGR 180; 8 additional upper-division units in Computer Science. Student teams plan, design, implement, test, and document a Database-related system using techniques from previous related courses. Requires a written report and an oral presentation. Emphasizes professional and ethical responsibilities and the need to stay current on technology and its global impact on economics, society, and the environment.

CS 179I. Networks (4) Discussion, 1 hour; laboratory, 9 hours. Prerequisite(s): CS 141 and CS 164 with grades of "C-" or better; ENGR 180; 8 additional upper-division units in Computer Science. Student teams plan, design, implement, test, and document a Network-related system using techniques from previous related courses. Requires a written report and an oral presentation. Emphasizes professional and ethical responsibilities and the need to stay current on technology and its global impact on economics, society, and the environment.

CS 179J. Computer Architecture and Embedded Systems (4) Discussion, 1 hour; laboratory, 9 hours. Prerequisite(s): CS 122A, CS 141, and CS 161 with grades of "C-" or better or consent of instructor; ENGR 180; 3 additional upper-division units in Computer Science. Student teams plan, design, implement, test, and document a Computer Architecture and Embedded Systems related system using techniques from previous related courses. Requires a written report and an oral presentation. Emphasizes professional and ethical responsibilities and the need to stay current on technology and its global impact on economics, society, and the environment.

CS 179K. Software Engineering (4) Discussion, 1 hour; laboratory, 9 hours. Prerequisite(s): CS 141 with a grade of "C-" or better; CS 180; ENGR 180; 8 additional upper-division units in Computer Science. Student teams plan, design, implement, test, and document a Software Engineering-related system using techniques from previous related courses. Requires a written report and an oral presentation. Emphasizes professional and ethical responsibilities and the need to stay current on technology and its global impact on economics, society, and the environment.

CS 179M. Artificial Intelligence (4) Discussion, 1 hour; laboratory, 9 hours. Prerequisite(s): CS 141 and CS 170 with grades of "C-" or better; ENGR 180; 8 additional upper-division units in Computer Science. Student teams plan, design, implement, test, and document an Artificial Intelligence-related system using techniques from previous related courses. Requires a written report and an oral presentation. Emphasizes professional and ethical responsibilities and the need to stay current on technology and its global impact

Basic Information

Grade Breakdown

- 10%: Weekly participation
- 10%: Online logs and homeworks
- 10%: Quizzes
- 5%: Tradeoff analysis
- 5%: Proposal
- 15%: First prototype and presentation
- 15%: Second prototype and presentation
- 15%: Final implementation
- 15%: Final report, presentation and interview

Students must keep a weekly log that includes hours spent, tasks, issues, and plans. Logs for a week should be done by Friday at 3:00 -- best to update logs daily though. Keeping a log is good engineering practice. Here is a sample of a good log from a previous quarter: Sample Student Log. Please copy the format (save as html, then edit the html). Students should provide the TA with the log's URL, which should be in their UCR account (no off-campus URLs).

Final Report Templates for EE-175

Note: For brevity and clarity, just the first page of the template is shown full size. The rest of this document is print two-per-page

EE175AB Final Report Template

Project Title

EE 175AB Final Report

Department of Electrical Engineering, UC Riverside

Project Team Member(s)	
Date Submitted	
Section Professor	
Revision	e.g., revision 2.1
URL of Project Wiki/Webpage	http://

Summary

This report presents …….

Note:

- **Sections marked with * are required**
- **In each section, you must clearly identify which team member is responsible for which objectives, modules or tasks.**

Table of Contents

Team name, team logo
Dept. of Electrical Engineering, UCR
EE175AB Final Report: Title
Date & version #

Team name, team logo
Dept. of Electrical Engineering, UCR
EE175AB Final Report: Title
Date & version #

1 * Executive Summary

In one page, present the summary of your project. Outline the overall goals, design objectives, the chosen method, key features, testing results, and your important achievements. You may use several paragraphs, but no more sub-sections.

2 * Introduction

This space may be used to provide an introduction for the design and ties to other project materials.

2.1 * Design Objectives and System Overview

High-level description of overall goals, the intended , the application, system structure, functionality, interactions with external systems, system issues, operating environment, user environment, inputs, outputs, etc. You do not need to provide implementation details in this section.

You must provide a list of quantitative technical design objectives, e.g., accuracy of 95%, sensor range of 20 feet, 90% successful retrieval or recognition, mean square error < 0.1, response time < 1ms, dynamic range of 20Vp-p, bandwidth of 20MHz, transmission range>100m at 100mW, SNR>10dB, data transfer rate = 100Mbps, costing less than $500, etc.

Responsibilities: clearly state which team member is responsible for which goals/objectives

2.2 * Development Environment and Tools

Describe any design environment or tools used in this project.

2.3 Related Documents and Supporting Materials

References to any industry standards involved in your project should be listed here.

(Optional) – Note any other references or related materials. For instance, if this design required interfacing with X10 hardware devices, then you would want a reference the X10 specification. If you use the .NET development environment or need to interface with MS Internet Explorer, the related documents should be referenced here.

2.4 * Definitions and Acronyms

List any project definitions and acronyms introduced to the project by this design.

3 * Design Considerations

This section describes issues that need to be addressed or resolved prior to or while completing the design as well as issues that may influence the design process.

3.1 * Assumptions

Describe any assumption, background, or dependencies of the end product, its use, the operational environment, or significant project issues. These are things you are assuming to be true, that directly affect the design.

3.2 * Realistic Constraints

Describe any constraints on the system that have a significant impact on the design of the system. (e.g. technology constraints such as power constraints, processor speed/memory size constraints, frequency constraints, performance requirements, end user characteristics, weight/size constraints, validation requirements, project constraints, government regulations and legal constraints, societal and environmental constraints, requirements of industry standards, cost constraints, etc.)

3.3 * System Environment and External Interfaces

Describe the system, hardware and software that your product must operate in and interact with, any communication protocols and APIs the system must comply to, etc.

3.4 * Industry Standards

Describe the industry standards involved with the hardware and software in your design. This may include hardware, software and protocols, such as RS232, I2C, USB, IEEE802.11, Bluetooth, RFID, Windows API, device drivers, etc. Reference the standards documents and describe how you design will comply with the standards.

3.5 * Budget and Cost Analysis

Present your budget and/or cost analysis.
safety, ethics, and social
impacts, must be addressed explicitly herein. You may use a table to respond briefly about some
of these matters that are tangentially related to your project.

3.6 * Safety

Discuss safety considerations and specify safety objectives

3.7 Performance, Security, Quality, Reliability, Aesthetics etc.

Describe the considerations and processes to ensure meeting performance, security, quality control, reliability, aesthetics etc. requirements.

3.8 * Documentation

Describe the processes for generating and maintaining technical and user documentation for the project, including design notes, engineering change notices, version update and version control procedures.

3.9 Design Methodology

(Optional) - Summarize the approach that will be used to create and evolve the designs for this system. Cover any processes, conventions, policies, techniques, development environments, tool or other issues which will guide design work. This is not a rehash of your project lifecycle or change management. This is for deciding whether you will use structured, object-oriented, formal specification or other specific methodologies..

3.10 Risks and Volatile Areas

(Optional) - Describe any notably volatile or risky areas of the system and any special strategies taken to mitigate risks or prepare for changes. These are risks specific for the design—not project management type stuff. For instance if there is an algorithm that is especially difficult that you must implement.

3.11 * Global, Economic, Environmental and Societal Impact

Include an essay (800 or more words) that discusses the potential global, economic, societal, and environmental impact of the project. You do not need to address every aspect, just focus on a couple of aspects that are related to your project. For example, if your project is made into a product, how will it improve quality of life, affect the environment, enhance entertainment, education, globalization etc.? Are there any ethical or political debates, laws and regulations that are related to your project?

Every team member must contribute to this essay and it must state that every team member contributed to this essay.

3.12 * Contemporary Engineering Issues

Include an essay (800 or more words) on the contemporary engineering issues related to the project. Potential contemporary engineering issues related to your project are new technologies, new industry standards, new design methods, new materials, new trends in manufacturing, etc.

Every team member must contribute to this essay and it must state that every team member contributed to this essay.

4 Experiment Design and Feasibility Study

Include this section if you need to conduct experiments to evaluate the feasibility of your project ideas, alternatives, trade-offs and realistic engineering constraints, and to answer key design questions, such as what parts to use, how to collect data, whether accuracy of sensor is sufficient for the design objective, whether battery provides enough power, what hardware or software interface methods to use to connect the different modules, etc.

4.1 Experiment Design

Describe the objective, setup, procedure and expected results of each experiment.

State clearly who is responsible for which task

4.2 Experiment Results and Feasibility

Carry out the experiments designed above and present experimental data, quantitative analysis of the data, and the conclusion to show the feasibility of your project idea, how the experiments help you decide whether your technical design objectives can be achieved, and how they help you select the best solution to be further developed in the design project.

State clearly who is responsible for which task

5 Architecture

The architecture provides the top level design view of a system and provides a basis for more detailed design work. These are the top level components of the system you are building and their relationships.

5.1 System Architecture

This section provides a high level overview of the structural and functional decomposition of the system. Focus on how and why the system is decomposed in a particular way rather than on details of the particular components. Include information on the major responsibilities and roles the system (or portions thereof) must play. A pictorial representation of the architecture should be presented, which should show the hierarchical structure of the modules; interaction and interface among modules and with databases, external software, system, and networks

State clearly who is responsible for which module/task

5.2 Rationale and Alternatives

This section discusses why you are using the architecture or approach you have decided upon. A discussion of other architectures or approaches considered should be presented here.

State clearly who is responsible for which module/task

6 * High Level Design

This section describes in further detail elements discussed in the Architecture. Normally this section may be split into separate documents for different areas of the design.

High-level designs are most effective if they attempt to model groups of system elements from a number of different views. Typical viewpoints are:

a. Conceptual or Logical: this is the view most often used in Section 3. This view shows the logical functional elements of the system. Each component represents a similar grouping of functionality. For UML, this would be a component diagram or a package diagram..

b. Hardware: this view is for hardware functional blocks and how they interface.

c. Software: this view is the software view of the system. The components are modules, threads, processes or distributed applications.

d. Security: this view typically focuses on the components that cooperate to provide security features of the system. It is often a subset of the Conceptual view.

For many smaller applications, the conceptual view is all that is necessary. Document those views that will help you design and implement the system. If you have only a single view, and that view is discussed adequately in section 3, then this entire section can be deleted.

State clearly who is responsible for which module/task

6.1 Conceptual View

Provide a description and diagrams of a system element or set of elements that describes a clearly defined view or model of the entire system or a subset of the system.

State clearly who is responsible for which module/task

6.2 Hardware

State clearly who is responsible for which module/task

6.3 Software

State clearly who is responsible for which module/task

7 Data Structures

A description of all data structures including internal, global, and temporary data structures. State clearly who is responsible for which module/task

7.1 Internal software data structure

Data structures that are passed among components the software are described.

7.2 Global data structure

Data structured that are available to major portions of the architecture are described.

7.3 Temporary data structure

Files created for interim use are described.

7.4 Database descriptions

Database(s) created as part of the application is(are) described.

Final Report Templates for CS 179

Note: The format of the Final report varies slightly depending on the area. Recall that students may choose from: CS 179E. Compilers , CS 179F. Operating Systems, CS 179G. Database Systems, CS 179I. Networks, CS 179J. Computer Architecture and Embedded Systems, CS 179K. Software Engineering ,CS 179M. Artificial Intelligence

For brevity and clarity, just the template from Database Systems is shown, the others are very similar.

Below we have listed an approximate format of your report. Your report may use slightly different headings or merge or split some sections, depending on your design philosophy. I do however expect you to address all the issues hinted at below.

- Title Page
-
- Requirements Analysis.
  - Requirements Elicitation.
  - System Specification.
- System Design:
- Program Design:
- Coding:
- Unit and Integration Testing:
- System Testing:
- Acceptance Testing:
- **A Maintenance Plan:** Assume that like the vast majority of software that is commissioned, your contract requires you to maintain the software.
- **Conclusions:** Assume that you write this just before handing in your document. Summarize briefly what you did for you project. Address the following; what most surprised you about the process of creating the project. What would you do differently if you had to do it again?
- **References:** Every, book, paper, webpage you used must be cited in a standard format. You could use the American Psychological format [1, 2], or the IEEE standard [3], or any other format so long as you are consistent and complete. You should also reference any standard template libraries used in your code.
- **Appendices:** Including source code, printed in 2 "pages" per page format. You should also list a professional quality, one-page resume for each member of the group (use the same template for each).
- **Acknowledgements:** Your chance to thank anyone who helped you complete the project.
- **Two (identical) Cd roms in a high quality plastic wallet:** Containing source code, test data, all the weekly archives, and a readme.txt file that contains a brief (one line) description of all the files.

[1] Burgess, P., S. (1995). A Guide for Writing Research Papers based on Styles Recommended by The American Psychological Association. Online at http://webster.commnet.edu/apa/apa_index.htm

[2] Coppola, L. (2000). The APA Citation Format. Rochester Institute of Technology, Wallace Library Online at http://wally.rit.edu/pubs/guides/apa.html

[3] Institute of Electrical and Electronics Engineers (2000). Computer science style guide. Online at http://www.computer.org/author/style/refer.htm also see http://www.ece.utoronto.ca/ece496/IEEEXManuscriptXFormat.pdf

You need to choose a member of your group to act as an archivist. Every Sunday night (or early Monday morning), the archivist must create a zip file that contains all files (including source code, notes, documentation and emails between group members) your group has created in the last week. The file name should be a concatenation of the group members last names (in alphabetical order), separated by underscores and followed by the week number. For example: Jones_Smith_Zoe_Week7.zip

These files must be copied onto the Cd-roms at the end of the quarter. In addition I reserve the right to ask to inspect the files at random times throughout the quarter.

In addition, the CD-Roms should contain your final, working project, together with a readme.txt file that clearly explains how to get it up and running.

Project Binder Format

At the end of the quarter you will hand in a white 1½ inch, 3-ring binder, which contains, on the last page, a double CD wallet containing two copies of your archive (more on this later). Please note that you will not get this binder back, so you may wish to make an extra copy for yourself.

The front clear face of the binder must have the following information, in exactly this format.

University of California - Riverside
Computer Science & Engineering Department

CS 190 Project: Winter 2002
"A database of ATM machines in Riverside, which supports spatial queries".

Instructor: Dr Eamonn Keogh

Team: Smith-Jones-Patel

Mike Smith:	**smith@cs.ucr.edu**	**(949) -878-3423**
Susan Jones:	**sue@cs.ucr.edu**	**(949) -878-2345**
Anita Patel:	**patel@cs.ucr.edu**	**(949) -456-3423**

Appendix H: Catalog Descriptions for CS/EE 120A

Revised Catalog text for EE 120A and EE 120B

EE 120A. Logic Design (5) Lecture, 3 hours; laboratory, 6 hours.
Prerequisite(s): CS 061 with a grade of "C-" or better. Covers the design of digital systems. Topics include Boolean algebra; combinational and sequential logic design; design and use of arithmetic-logic units, carry-lookahead adders, multiplexors, decoders, comparators, multipliers, flip-flops, registers, and simple memories; state-machine design; and basic register-transfer level design. Interdisciplinary laboratories involve use of hardware description languages, synthesis tools, programmable logic, and significant hardware prototyping. Cross-listed with CS 120A.

EE 120B. Introduction to Embedded Systems (5) Lecture, 3 hours; laboratory, 6 hours. Prerequisite(s): CS 120A/EE 120A. Introduction to hardware and software design of digital computing systems embedded in electronic devices (such as digital cameras or portable video games). Topics include embedded processor programming, custom processor design, standard peripherals, memories, interfacing, and hardware/software tradeoffs. The interdisciplinary laboratory involves use of synthesis tools, programmable logic, and microcontrollers and development of working embedded systems. Cross-listed with CS 120B.

Appendix I: Syllabus for CS/EE 120A

Department of Electrical Engineering, University of California – Riverside

EE 120A LOGIC DESIGN

(Prerequisite: CS 061)
Lecture:
Section 001: MWF 2:10 – 3:00 p.m., Boyce Hall 1471
Instructor: Dr. Vladimir Fonoberov
Web: http://www.faculty.ucr.edu/~vladimf/ & http://www.iLearn.ucr.edu/
Office Hours: MW 1:10 – 2:00 p.m., ENGR2 408
Labs:
Section 021: MT 6:10 – 9:00 p.m., ENGR2 125
TA: Lingfei Zhou (lzhou001@student.ucr.edu)
Section 022: RF 11:10 a.m. – 2:00 p.m., ENGR2 125
TAs: Ben Fellows (bfellows@ee.ucr.edu) & Zhuo Zhao (zhaozhuo@ee.ucr.edu)

Catalog Description:
Covers the design of digital systems. Topics include Boolean algebra; combinational and sequential logic design; design and use of arithmetic-logic units, carry-lookahead adders, multiplexors, decoders, comparators, multipliers, flip-flops, registers, and simple memories; statemachine design; and basic register-transfer level design. Laboratories involve use of hardware description languages, synthesis tools, programmable logic, and significant hardware prototyping.

Text: "***Digital Design***" by Frank Vahid, John Wiley & Sons, 2006 (ISBN 0-471-46784-7)

Homework: Four homework assignments will be given during the course. Solution of the homework problems will normally require reading the book, working on examples, and reviewing class material. Homework must be typed or very neatly written.

Quizzes: Four 50-minute quizzes will be given during the course.

Labs: Eight lab assignments and one lab exam will be given. Lab attendance is required for the full 3- hour lab. For the first part of the course, the Instructor and TAs will form interdisciplinary teams of two students, e.g. one EE student and one CS/CE student. New teams will be formed each week (for each lab assignment). Each lab report must show students' names and majors.

Midterm: February 9, 2007 (subject to change)
Final Exam: March 22, 2007; 8 – 11 a.m.
Grading:
• **Lecture component** (70 points)
- 30 pts: Final
- 20 pts: Midterm
- 10 pts: Quizzes (4 @ 2.5 pts)
- 10 pts: Homework (4 @ 2.5 pts)

• **Lab component** (30 points)
- 24 pts: Lab assignments (8 @ 3 pts)
- 6 pts: Lab practical exam

Appendix J

Documentation for Criterion 3

This Appendix contains the rest of the documentation for Chapter 3, "Corrective Action Regarding Criterion 3."

J.1 The EBI Exit Survey

Each year the Bourns College of Engineering administers an exit survey to its graduating seniors. The instrument Educational Benchmarking Inc. (EBI). It involves 86 seven-point Likert items,[1] 26 of which are directly oriented toward the a-k outcomes.[2] Those items are of the formats: *"To what degree did your engineering education enhance your ability to ...?"* and *"To what degree did your systems design experience address ...?"* The items are also reported in terms of 15 clusters:

- Factor 1: Instruction & Interaction in Major Courses
- Factor 2: Aspects of Major Courses

[1] Answered on the basis of:

1. Very dissatisfied
2. Moderately dissatisfied
3. Slightly dissatisfied
4. neutral
5. Slight satisfied
6. Moderately satisfied
7. Very satisfied

[2] The expansion from 11 outcomes to 26 items is the result of expanding all conjunctions, e.g., outcome a generates three items, one for science, one for mathematics, and one for engineering.

- Factor 3: Breadth of Curriculum
- Factor 4: Team and Extracurricular Activities
- Factor 5: Computing Resources
- Factor 6: Fellow Students
- Factor 7: Career Services and Job Placement
- Factor 8: System Design & Problem Solving
- Factor 9: Impact of Engineering Solutions
- Factor 10: Use of Tools and Text
- Factor 11: Apply Knowledge and Identify Problems
- Factor 12: Design Experience Built on Coursework
- Factor 13: Design Experience issues
- Factor 14: Laboratory Facilities
- Factor 15: Overall Program Effectiveness

Some of these clusters overlap, and nine of the 86 items fall into none of these clusters. Each item come with five years of longitudinal data

Notes.

1. Because the CE major was begun in 2000 there were relatively few CE graduates until 2004, and those few were surveyed among the CS graduates.
2. We get longitudinal data for each item, and we get comparison to six selected comparison institutions.

J.2 CE's program outcomes

In accordance with Criterion 3, the program outcomes describe what students are expected to know and be able to do as of graduation. And, as mentioned above, CE and EE have both adopted ABET's a-k outcomes as their program outcomes:

a. an ability to apply knowledge of mathematics, science, and engineering

b. an ability to design and conduct experiments, as well as to analyze and interpret data

c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

d. an ability to function on multi-disciplinary teams

e. an ability to identify, formulate, and solve engineering problems

f. an understanding of professional and ethical responsibility

g. an ability to communicate effectively

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

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

j. a knowledge of contemporary issues

k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

J.3 Course matrix for CS/EE 120B

J.4 Working Notes

```
- Add the revision that Harry and Sheldon made to the list of improvements.  It was
  based on time-to-degree data.

- For case 7:
    -- Proposal creating Engineering 180.  Senate approval.
    -- Proposal to require Engineering 180 in Comp Sci, Senate approval.
    -- Proposal to require Engineering 180 in Comp Engr, Senate approval.
    -- Proposal to make E 180 a prerequisite for CS 179, and Senate approval.
    -- Proposal to make E 180 a prerequisite for EE 175A, and Senate approval.

    -- Proposal to create CS/Math 11. Senate approval.
    -- Proposal to create CS/Math 111. Senate approval.
    -- Proposal to CS/Math 111 a prerequisite for CS 141.  Senate approval.
    -- Proposal to require CS/Math 11 and CS/Math 111 Computer Engineering.
       Senate approval.


    -- When first offered.  (Aaron Potter Spring 2005, I think).
    -- Gradebooks for CS 179 and EE 175 for that period.
    -- Information from EE
```

- For the assessment of outcome c add the following as 3.13 in the CS 179/EE 175 final-report template: Include an essay (800 or more words) that discusses how your design meets realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

- Provide an updated CS 179/EE 175 template with 3.13 added per my email to Amit.

- Get a copy of the past EBI's from Tim. CS, CE, and EE.

- The improved career counseling has been designed to improve the degree to which we attain our PEOs.

- Incorporate Figure 8 (aka Figure X) from EE's self study.

- Document improvements.

- Document course content.

- Reduce prose regarding the process.

- Does it really require a ''C-'' or better for a course to fulfill a major requirement. NO! except in case where follow-on course requires it.

- Provide old and new course plans for computer engineering. Suzanne sent 6/11.

- Focus on a couple of cases of improvement.

- Find out which quarter Frank had that epiphany (Case 8).

- In EE 175 and in CS 179 do we record in the gradebook separate components for each of the outcomes it supports. We need that this time.

- The key courses
  - EE 175AB
  - CS 179
  - CS/EE 120AB
  - EE 100A
  - EE 01AB
  - CS 141
  - Engineering 180

```
- Needed for each key course
  o latest course description
  o course syllabus
  o course objectives
  o course matrix
  o for this year and last:
    . gradebooks
    . copies of assignments (just the assignment, not student work)
    . final exam copy (just the exam, not student work)

- This quarter's gradebooks for CS 179 and EE 175AB need to show
  separate scores for outcomes b, c, f, h, and j
```

J.5 Notes on Criterion 3

The loop to measure the attainment of a-k outcomes and adjust the curriculum accordingly:

- *Append a copy of the online alumni survey.*
- *Append a full set of course matrices with course objectives.*
- *Attribute Case 1 to an inspection of gradebooks as well.*
- *Consider adding the CS 161 case.*
- *Find out what EBI stands for and append a copy of the EBI survey.*
- *Ask EE for an instance of closing the loop relative to outcomes.*
- *Get syllabus for CS 120B and add it to Appendix D.*
- *EE has taken care of b, f, h, and j via senior design.*
- *It looks like a, c, e, and k are covered by the Senior Design classes, and most other technical classes as well. See what EE's self-study says about them.*
- *EE has taken care of d via CS/EE 120AB, and so do we.*
- *g is covered by Engr 180.*
- *i is covered by the Alumni Survey.*
- *We should go back to EE's original filing and ask how they satisfied those. We may be able to piggy back on some more of their effort, for example, if they cover outcome x with a course that is required of CompE majors.*
- *On the rest, we should go through the College degree by degree, looking at how they addressed each, and mimic they efforts.*

[ ] Mitch disagrees, but I think that relative to attaching the entire report rather than simply a sample survey. Resolve this.

- *What is the process?*
- *What evidence do we have?*
- *Also, we can look at MechE, EnvE, and ChemE responses on Criterion 3.*
- *Other aspects of our process:*
  - *EBI surveys*
  - *quarterly course evaluations by campus*
  - *quarterly course evaluations by departments*
  - *lecturers' meetings.*
  - *the course-based system mentioned in our due-process followup.*
  - *Annual Board of Advisers meeting.*
  - *Annual Faculty retreat.*
  - *grade and retention data and cheating data.*
- *program improvements resulting from data:*
  - *adding Engr 180*
  - *lab upgrades*
  - *change of personnel in lecturers*
  - *collaborative learning in CS 10, 12, 14*
  - *reducing the number of required courses.*
  - *introduction of Math/CS 11 and Math/CS 111*
  - *new course plan for Computer Engineering.*
- *Attach the relevant EBI surveys per CASE 3.*
- *Attach CS&E's 2001 five-year plan per CASE 3.*
- *Attach a sample EBI survey.*

J.6 Background Documents

- The filing by UCR in Spring 07
- EAC's Draft Statement
- Our due-process response to the EAC's Draft Statement
- EAC's Final Statement.
- Eamonn's draft response to Final Statement.
- EE's draft response to Final Statement.

Appendix K

Course Matrix for CS 14

Course objectives for CS 14:

1. Design and use arrays, lists, stacks and queues, and know when each is most appropriate
2. Design and use binary search trees
3. Design and use hash tables
4. Design and use heaps
5. Understand basic algorithm analysis
6. Be able to design and use several different sorting algorithms, understanding the differences and trade-offs among them
7. Basic understanding of object-oriented programming, including abstract data types, inheritance and polymorphism
8. Convert a problem description into an algorithm that efficiently solves the problem
9. Convert a problem description into a program 200-400 lines long
10. Debug programs written by oneself or by others
11. Make extensive use of software tools, including debuggers, in writing programs
12. Know how to thoroughly test programs

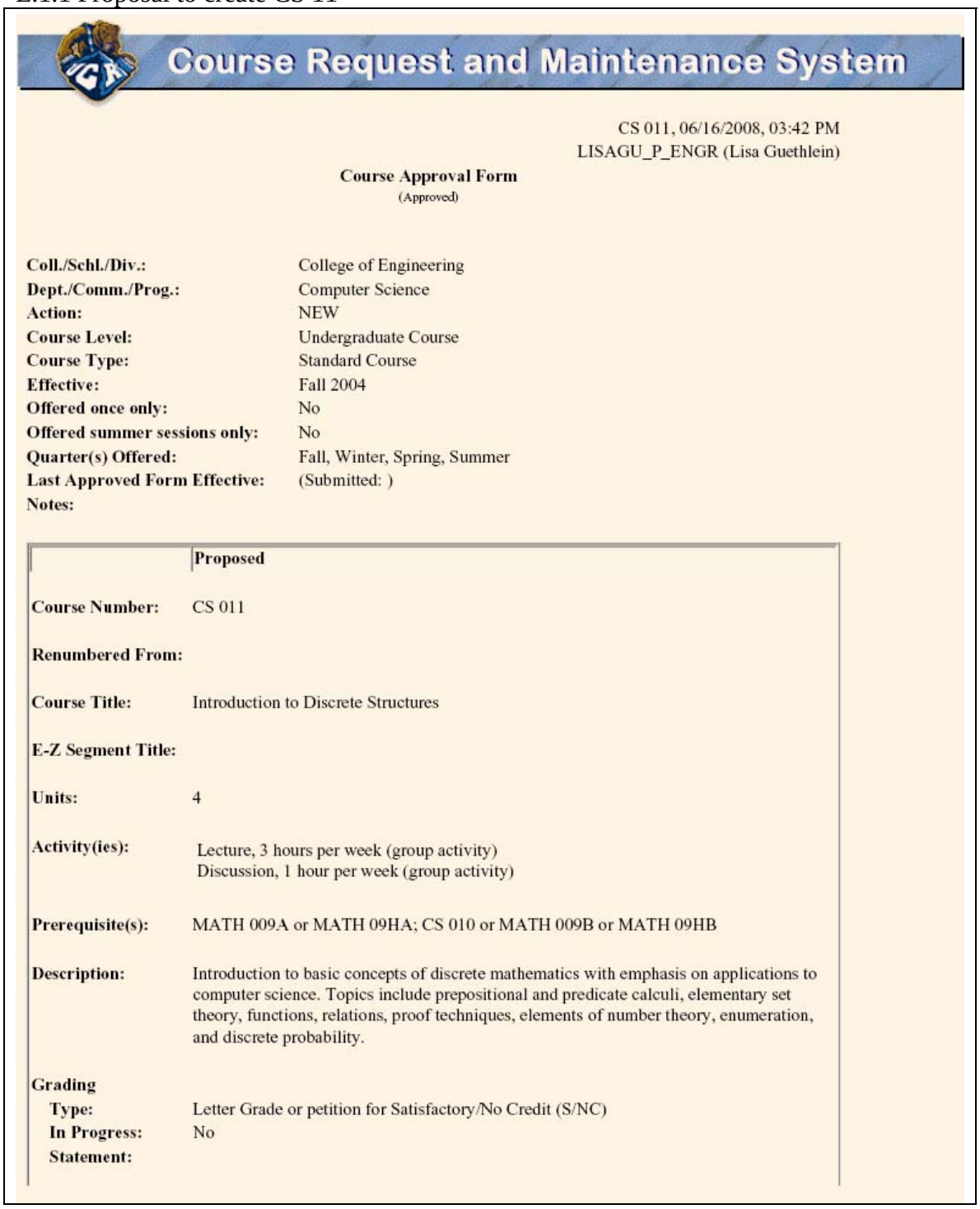
Relationship of course to program outcomes: The contribution of CS14 to program outcomes (a)-(k) is summarized in the objective-outcome matrix table: 0-none, 1-slightly, 2-moderately, 3-substantially

objective	a	b	c	d	e	f	g	h	i	j	k
1	2		1								3
2	2		1								3
3	2		1								3
4	2		1								3
5	3	1									3
6	2		3								3
7						1					3
8	3										3
9	2		3								3
10	1	3									3
11	3										3
12	2	3				1					3

Appendix L: Assessment Driven Improvements

L.1 CS 141: Prerequisites.

L.1.1 Proposal to create CS 11



Course Request and Maintenance System

CS 011, 06/16/2008, 03:42 PM
LISAGU_P_ENGR (Lisa Guethlein)

Course Approval Form
(Approved)

Coll./Schl./Div.:	College of Engineering
Dept./Comm./Prog.:	Computer Science
Action:	NEW
Course Level:	Undergraduate Course
Course Type:	Standard Course
Effective:	Fall 2004
Offered once only:	No
Offered summer sessions only:	No
Quarter(s) Offered:	Fall, Winter, Spring, Summer
Last Approved Form Effective:	(Submitted:)
Notes:	

	Proposed
Course Number:	CS 011
Renumbered From:	
Course Title:	Introduction to Discrete Structures
E-Z Segment Title:	
Units:	4
Activity(ies):	Lecture, 3 hours per week (group activity) Discussion, 1 hour per week (group activity)
Prerequisite(s):	MATH 009A or MATH 09HA; CS 010 or MATH 009B or MATH 09HB
Description:	Introduction to basic concepts of discrete mathematics with emphasis on applications to computer science. Topics include prepositional and predicate calculi, elementary set theory, functions, relations, proof techniques, elements of number theory, enumeration, and discrete probability.
Grading	
Type:	Letter Grade or petition for Satisfactory/No Credit (S/NC)
In Progress:	No
Statement:	

Repeatable: No
Maximum Units:
Statement:

Cross-listed With: MATH 011

Credit Statement:

If repeatable, may be taken more than once per quarter: No

Breadth Statement:

Instructor(s): Professor Bun Wong

Justification:

The two course sequence, CS 11 and CS 111, will replace Math 112 in degree requirements for majors in Computer Science, Computer Engineering, Information Systems, and for minors in Computer Science.

Discrete mathematics is one of the foundations of Computer Science, as much as calculus is at the core of other engineering disciplines. Our experience with upper division Computer Science courses reveals that CS majors need not only deeper understanding of the topics in discrete mathematics that are currently covered in Math112, but also need to be exposed to other topics, like number theory and abstract (finite) algebra. For example, the number theory has become the basis of modern cryptography and security.

Traditional courses in discrete mathematics offered as part of a CS curriculum focussed on sets, combinatorics, discrete probability, and graph theory. Today, more and more often, those courses include also logic, finite algebras, elements of number theory, plus various additional topics like coding and zero-sum games. Our proposal is consistent with this trend.

Correspondence:

Overlaps/Duplicates Other Courses:	Math 112--The course Mathematics 112 was created to provide computer science majors with an introduction to the discrete mathematics they need for courses in their major. The course has evolved as those needs have changed. Math 011 is a slight overlapping of the current Math 112 course. It is the result of extensive negotiations between our two departments. The reasons for the changes are: 1. The original title Finite Mathematics was no longer correct. While the terms finite mathematics and discrete mathematics might appear to be synonymous they have come to have different meanings. Discrete mathematics is the proper term for the course described above. 2. Moving the course to the lower division would encourage students to take it earlier in their academic career. Perhaps, more importantly it would match our course up with courses taught at community colleges. Both Mathematics and Computer Science have long pre-requisite strings. A community college student who takes the equivalent discrete mathematics course at the community college would far more efficiently join either of our programs. 3. Computer Science wanted the course cross-listed because such courses are cross-listed at many other universities, including several University of California campuses, and because it wants to more closely monitor the course content and delivery. Over time, the Mathematics Department has found that the Math 112 course has come to meet needs in our program as well, such as being a requirement in our subject matter preparation waiver program.
Affects Programs:	Math/CS 011 will be a required course for majors in Computational Math, Computer Science, Computer Engineering and Informational Systems. It will also be required for minor in Computational Science. CS 011 and CS 111 replace Math 112 in these program requirements.
Affects Prerequisites/Descriptions:	Math/CS 011 will be a prerequisite for Math/CS 111 and CS 014.

Syllabus:

MATH 11 & CS 11
FINITE MATHEMATICS

Text: Discrete Mathematics and its Applications, Fifth Edition, by K. H. Rosen.
An introduction to the basic concepts and structures of finite mathematics with emphasis on applications to computer science.

TOPICS SUGGESTED NO. OF 50 MIN. CLASSES

Logic, set theory and functions.....6
(Sections 1.1-1.7)

Propositions, truth tables, propositional equivalence, predicates, quantifiers, negation of a quantified expression. Sets, operations on sets, functions, sequences and summation, finite and infinite sets, Cantor's theorem.

Arithmetic and its algorithms.....5

(Sections 2.1-2.4 & 2.6)

Integers and their representations, algorithms for addition and multiplication, the Euclidean algorithm, primes, the Fundamental Theorem of Arithmetic. Matrices and matrix multiplication.

Mathematical reasoning.....5
(Sections 3.1-3.4)

Strategies for proofs (direct, by contradiction, by induction), counterexamples, proof of the Fundamental Theorem of Arithmetic, Cantor's diagonal argument. Recursive definitions and recursive algorithms.

Basic enumeration.....5
(Sections 4.1-4.6)

The Rule of Sum and Rule of Product, Dirichlet's Pigeonhole Principle, permutations and combinations, probability theory.

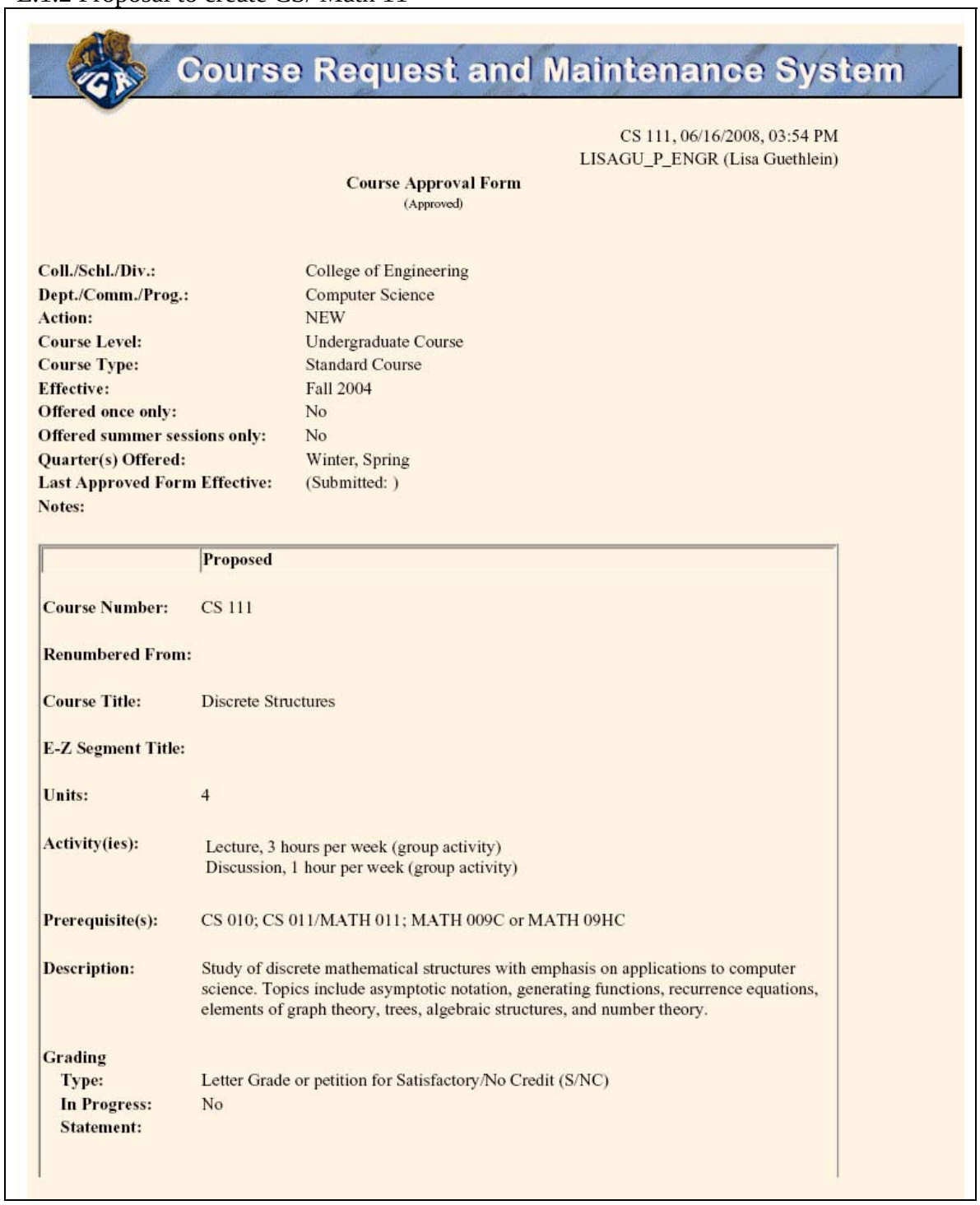
Relations.....5
(Sections 6.1-6.6)

Binary and n-ary relations and their properties, representations of relations, closures, equivalence relations and partial orders.

Approvals:		
Department/Committee/Program Faculty:		12/03/2003
Submitted by Department/Committee/Program Chair:	Tom Payne	12/03/2003
Reviewed by Courses Office:	Cheri Schillreff	12/24/2003
Reviewed by Dean of College/School/Division:		
Executive Committee		
College of Engineering:	Mart Molle	01/14/2004
College of Humanities, Arts, and Social Sciences:		
College of Natural and Agricultural Sciences:		
Division of Biomedical Sciences:		
Graduate School of Education:		
Graduate School of Management:		
University Honors Program:		
Dean of the Graduate Division:		
Graduate Council:		
Committee on Courses:	D. A. DEMASON	01/20/2004

L.1 CS 141: Prerequisites.

L.1.2 Proposal to create CS/ Math 11



Course Request and Maintenance System

CS 111, 06/16/2008, 03:54 PM
LISAGU_P_ENGR (Lisa Guethlein)

Course Approval Form
(Approved)

Coll./Schl./Div.:	College of Engineering
Dept./Comm./Prog.:	Computer Science
Action:	NEW
Course Level:	Undergraduate Course
Course Type:	Standard Course
Effective:	Fall 2004
Offered once only:	No
Offered summer sessions only:	No
Quarter(s) Offered:	Winter, Spring
Last Approved Form Effective:	(Submitted:)
Notes:	

	Proposed
Course Number:	CS 111
Renumbered From:	
Course Title:	Discrete Structures
E-Z Segment Title:	
Units:	4
Activity(ies):	Lecture, 3 hours per week (group activity) Discussion, 1 hour per week (group activity)
Prerequisite(s):	CS 010; CS 011/MATH 011; MATH 009C or MATH 09HC
Description:	Study of discrete mathematical structures with emphasis on applications to computer science. Topics include asymptotic notation, generating functions, recurrence equations, elements of graph theory, trees, algebraic structures, and number theory.
Grading	
Type:	Letter Grade or petition for Satisfactory/No Credit (S/NC)
In Progress:	No
Statement:	

Repeatable: No
Maximum Units:
Statement:

Cross-listed With: MATH 111

Credit Statement:

If repeatable, may be taken more than once per quarter: No

Breadth Statement:

Instructor(s): Professor Larry Harper

Justification:

The two course sequence, CS 11 and CS 111, will replace Math 112 in degree requirements for majors in Computer Science, Computer Engineering, Information Systems, and for minors in Computer Science.

Discrete mathematics is one of the foundations of Computer Science, as much as calculus is at the core of other engineering disciplines. Our experience with upper division Computer Science courses reveals that CS majors need not only deeper understanding of the topics in discrete mathematics that are currently covered in Math112, but also need to be exposed to other topics, like number theory and abstract (finite) algebra. For example, the number theory has become the basis of modern cryptography and security.

Traditional courses in discrete mathematics offered as part of a CS curriculum focussed on sets, combinatorics, discrete probability, and graph theory. Today, more and more often, those courses include also logic, finite algebras, elements of number theory, plus various additional topics like coding and zero-sum games. Our proposal is consistent with this trend.

Correspondence:

Overlaps/Duplicates Other Courses: No

Affects Programs: Math/CS 111 will be a required course for majors in Computational Math, Computer Science, Computer Engineering, and Information System. It will also be a requirement for minors in Computer Science. CS 011 and CS 111 replace Math 112 requirement in these degree programs.

Affects Prerequisites/Descriptions: Math/CS 111 will also be a prerequisite of Math 126 (replacing Math 125B) and will be a prerequisite of CS 141, 150, 234, 238.

Syllabus:

MATH 111 & CS 111
DISCRETE STRUCTURES

Text: *Discrete Mathematics and its Applications, Fifth Edition,* by K. H. Rosen.
A continuation of Math & CS 11, presenting more advanced concepts of discrete mathematics with applications to computer science.

TOPICS SUGGESTED NO. OF
50 MIN. CLASSES

Advanced Enumeration???..?????????.???????.?????..6
(Sections 1.8, 5.1-5.6)

Growth of functions, recurrence relations, solving linear relations with constant coefficients, generating functions, inclusion-exclusion.

Graphs?????????????????????????????????....7
(Sections 7.1-7.8)

Undirected and directed graphs, connectivity, planarity (theorems of Kuratowski & Euler), Euler paths and Hamiltonian paths.

Trees?????????????????????????????????.6
(Sections 8.1-8.6)

Rooted trees, n-ary trees, spanning subtrees, height, enumerations of trees (Cayley's theorem and Catalan numbers), tree traversal, optimal spanning trees.

Number Theory??????????..??..???????????????3
(Sections 2.3(from Modular Arithmetic) & 2.5)

Modular arithmetic, Chinese remainder theorem, Fermat's ?little? theorem,
RSA encryption.

Algebraic Structures?????????????????????????..4
(Supplementary material)

Monoids, groups, rings and fields. Homomorphisms and isomorphisms.

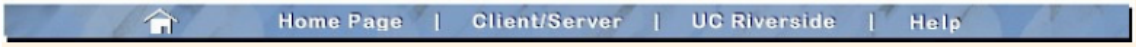
Approvals:

Department/Committee/Program Faculty:		12/03/2003
Submitted by Department/Committee/Program Chair:	Tom Payne	12/03/2003
Reviewed by Courses Office:	Cheri Schillreff	12/24/2003

Reviewed by Dean of College/School/Division:

Executive Committee

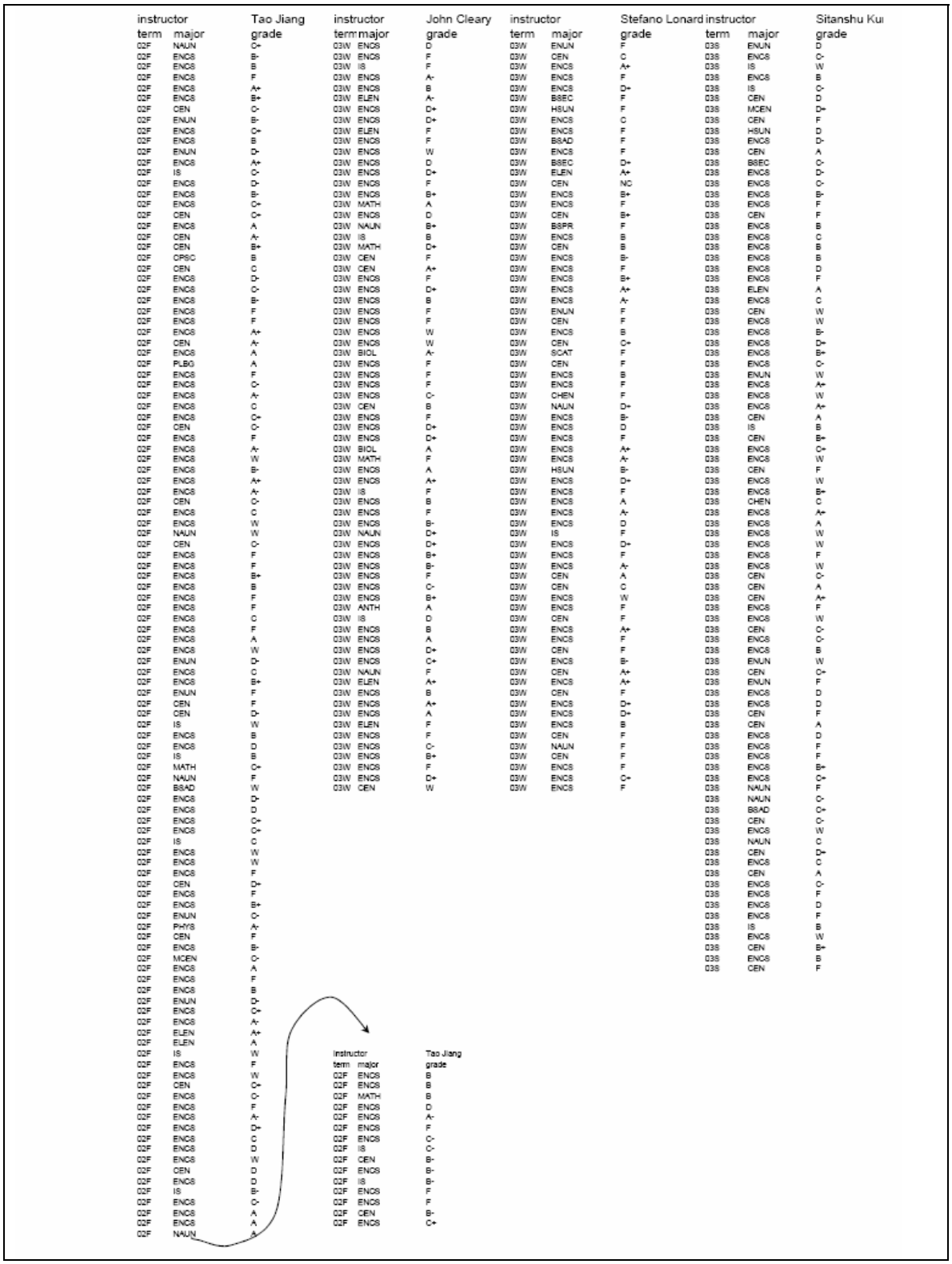
College of Engineering:	Mart Molle	01/14/2004
College of Humanities, Arts, and Social Sciences:		
College of Natural and Agricultural Sciences:		
Division of Biomedical Sciences:		
Graduate School of Education:		
Graduate School of Management:		
University Honors Program:		
Dean of the Graduate Division:		
Graduate Council:		
Committee on Courses:	D. A. DEMASON	01/20/2004



L.1 CS 141: Prerequisites.

L.1.3 Anonymized CS 141 Grades, 2002-02 and 2005-03

L.1.4 2002:03 Grades



instructor		Tao Jiang
term	major	grade
02F	NAUN	C+
02F	ENCS	B-
02F	ENCS	B
02F	ENCS	F
02F	ENCS	A+
02F	ENCS	B+
02F	CEN	C-
02F	ENUN	B-
02F	ENCS	C+
02F	ENCS	B
02F	ENUN	D-
02F	ENCS	A+
02F	IS	C-
02F	ENCS	D-
02F	ENCS	B-
02F	ENCS	C+
02F	CEN	C+
02F	ENCS	A
02F	CEN	A-
02F	CEN	B+
02F	CPSC	B
02F	CEN	C
02F	ENCS	D-
02F	ENCS	C-
02F	ENCS	B-
02F	ENCS	F
02F	ENCS	F
02F	ENCS	A+
02F	CEN	A-
02F	ENCS	A
02F	PLBG	A
02F	ENCS	F
02F	ENCS	C-
02F	ENCS	A-
02F	ENCS	C
02F	ENCS	C+
02F	CEN	C-
02F	ENCS	F
02F	ENCS	A-
02F	ENCS	W
02F	ENCS	B-
02F	ENCS	A+
02F	ENCS	A-
02F	CEN	C-
02F	ENCS	C
02F	ENCS	W
02F	NAUN	W
02F	CEN	C-
02F	ENCS	F
02F	ENCS	F
02F	ENCS	B+
02F	ENCS	B
02F	ENCS	F
02F	ENCS	F
02F	ENCS	C
02F	ENCS	F
02F	ENCS	A
02F	ENCS	W
02F	ENUN	D-
02F	ENCS	C
02F	ENCS	B+
02F	ENUN	F
02F	CEN	F
02F	CEN	D-
02F	IS	W
02F	ENCS	B
02F	ENCS	D
02F	IS	B
02F	MATH	C+
02F	NAUN	F
02F	BSAD	W
02F	ENCS	D-
02F	ENCS	D
02F	ENCS	C+
02F	ENCS	C+
02F	IS	C
02F	ENCS	W
02F	ENCS	W
02F	ENCS	F
02F	CEN	D+
02F	ENCS	F
02F	ENCS	B+
02F	ENUN	C-
02F	PHYS	A-
02F	CEN	F
02F	ENCS	B-
02F	MCEN	C-
02F	ENCS	A
02F	ENCS	F
02F	ENCS	B
02F	ENUN	D-
02F	ENCS	C+
02F	ENCS	A-
02F	ELEN	A+
02F	ELEN	A
02F	IS	W
02F	ENCS	F
02F	ENCS	W
02F	CEN	C+
02F	ENCS	C-
02F	ENCS	F
02F	ENCS	A-
02F	ENCS	D+
02F	ENCS	C
02F	ENCS	D
02F	ENCS	W
02F	CEN	D
02F	ENCS	D
02F	IS	B-
02F	ENCS	C-
02F	ENCS	A
02F	ENCS	A
02F	NAUN	A

instructor		John Cleary
term	major	grade
03W	ENCS	D
03W	ENCS	F
03W	IS	F
03W	ENCS	A-
03W	ENCS	B
03W	ELEN	A-
03W	ENCS	D+
03W	ENCS	D+
03W	ELEN	F
03W	ENCS	F
03W	ENCS	W
03W	ENCS	D
03W	ENCS	D+
03W	ENCS	F
03W	ENCS	B+
03W	MATH	A
03W	ENCS	D
03W	NAUN	B+
03W	IS	B
03W	MATH	D+
03W	CEN	F
03W	CEN	A+
03W	ENCS	F
03W	ENCS	D+
03W	ENCS	B
03W	ENCS	F
03W	ENCS	F
03W	ENCS	W
03W	ENCS	W
03W	BIOL	A-
03W	ENCS	F
03W	ENCS	F
03W	ENCS	F
03W	ENCS	C-
03W	CEN	B
03W	ENCS	F
03W	ENCS	D+
03W	ENCS	D+
03W	BIOL	A
03W	MATH	F
03W	ENCS	A
03W	ENCS	A+
03W	IS	F
03W	ENCS	B
03W	ENCS	F
03W	ENCS	B-
03W	NAUN	D+
03W	ENCS	D+
03W	ENCS	B+
03W	ENCS	B-
03W	ENCS	F
03W	ENCS	C-
03W	ENCS	B+
03W	ANTH	A
03W	IS	D
03W	ENCS	B
03W	ENCS	A
03W	ENCS	D+
03W	ENCS	C+
03W	NAUN	F
03W	ELEN	A+
03W	ENCS	B
03W	ENCS	A+
03W	ENCS	A
03W	ELEN	F
03W	ENCS	F
03W	ENCS	C-
03W	ENCS	B+
03W	ENCS	F
03W	ENCS	D+
03W	CEN	W

instructor		Stefano Lonardi
term	major	grade
03W	ENUN	F
03W	CEN	C
03W	ENCS	A+
03W	ENCS	F
03W	ENCS	D+
03W	BSEC	F
03W	HSUN	F
03W	ENCS	C
03W	ENCS	F
03W	BSAD	F
03W	ENCS	F
03W	BSEC	D+
03W	ELEN	A+
03W	CEN	NC
03W	ENCS	B+
03W	ENCS	F
03W	CEN	B+
03W	BSPR	F
03W	ENCS	B
03W	CEN	B
03W	ENCS	B-
03W	ENCS	F
03W	ENCS	B+
03W	ENCS	A+
03W	ENCS	A-
03W	ENUN	F
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03W	ENCS	B
03W	CEN	C+
03W	SCAT	F
03W	CEN	F
03W	ENCS	B
03W	ENCS	F
03W	CHEN	F
03W	NAUN	D+
03W	ENCS	B-
03W	ENCS	D
03W	ENCS	F
03W	ENCS	A+
03W	ENCS	A-
03W	HSUN	B-
03W	ENCS	D+
03W	ENCS	F
03W	ENCS	A
03W	ENCS	A+
03W	ENCS	D
03W	IS	F
03W	ENCS	D+
03W	ENCS	F
03W	ENCS	A-
03W	CEN	A
03W	CEN	C
03W	ENCS	W
03W	ENCS	F
03W	CEN	F
03W	ENCS	A+
03W	ENCS	F
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03W	ENCS	B-
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03W	ENCS	A+
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03W	ENCS	D+
03W	ENCS	D+
03W	ENCS	B
03W	CEN	F
03W	NAUN	F
03W	CEN	F
03W	ENCS	F
03W	ENCS	C+
03W	ENCS	F

instructor		Sitanshu Kui
term	major	grade
03S	ENUN	D
03S	ENCS	C-
03S	IS	W
03S	ENCS	B
03S	IS	C-
03S	CEN	D
03S	MCEN	D+
03S	CEN	F
03S	HSUN	D
03S	ENCS	D-
03S	CEN	A
03S	BSEC	C-
03S	ENCS	D-
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03S	CEN	F
03S	ENCS	B
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03S	ENCS	D
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03S	ELEN	A
03S	ENCS	C
03S	CEN	W
03S	ENCS	W
03S	ENCS	B-
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03S	ENCS	B+
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03S	ENCS	W
03S	ENCS	F
03S	ENCS	W
03S	CEN	C-
03S	CEN	A
03S	CEN	A+
03S	ENCS	F
03S	ENCS	W
03S	CEN	C-
03S	ENCS	C-
03S	ENCS	B
03S	ENUN	W
03S	CEN	C+
03S	ENUN	F
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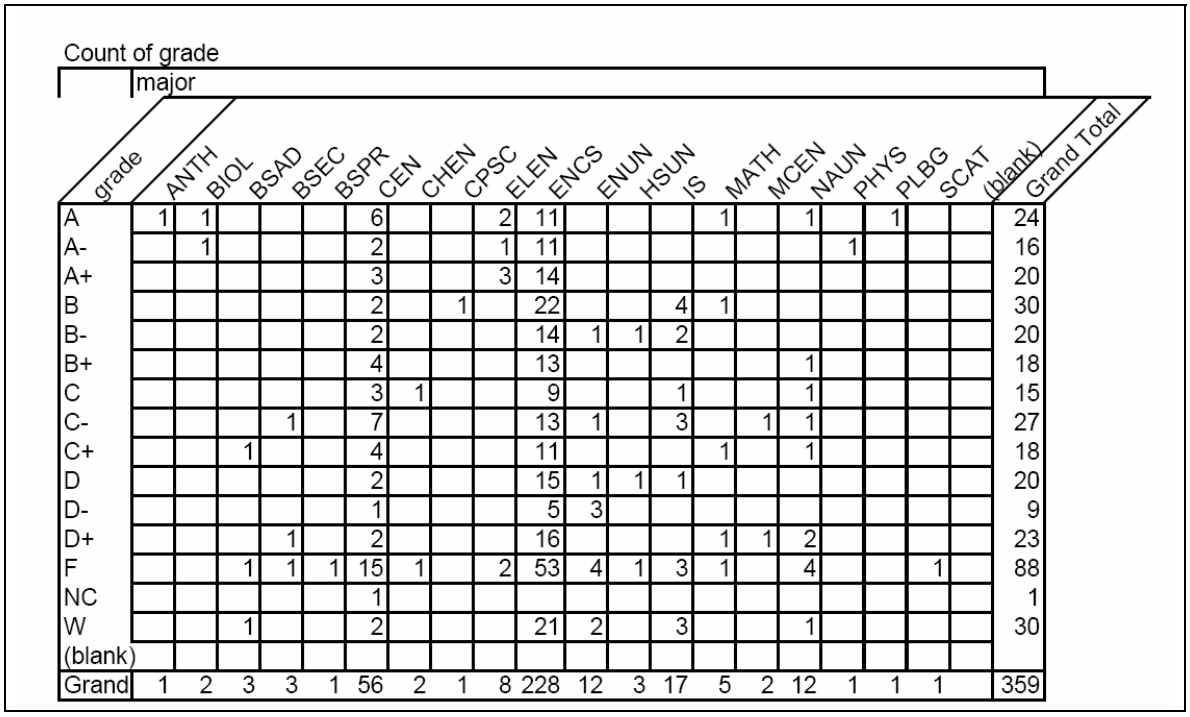
03S	CEN	A
03S	ENCS	D
03S	ENCS	F
03S	ENCS	F
03S	ENCS	B+
03S	ENCS	C+
03S	NAUN	F
03S	NAUN	C-
03S	BSAD	C+
03S	CEN	C-
03S	ENCS	W
03S	NAUN	C
03S	CEN	D+
03S	ENCS	C
03S	CEN	A
03S	ENCS	C-
03S	ENCS	F
03S	ENCS	D
03S	ENCS	F
03S	IS	B
03S	ENCS	W
03S	CEN	B+
03S	ENCS	B
03S	CEN	F

instructor		Tao Jiang
term	major	grade
02F	ENCS	B
02F	ENCS	B
02F	MATH	B
02F	ENCS	D
02F	ENCS	A+
02F	ENCS	F
02F	ENCS	C-
02F	IS	C-
02F	CEN	B-
02F	ENCS	B-
02F	IS	B-
02F	ENCS	F
02F	ENCS	F
02F	CEN	B-
02F	ENCS	C+

L.1.5 2002:03 Summary



Count of grade

grade	major																				
	ANTH	BIOL	BSAD	BSEC	BSPR	CEN	CHEN	CPSC	ELEN	ENCS	ENUN	HSUN	IS	MATH	MCEN	NAUN	PHYS	PLBG	SCAT	(blank)	Grand Total
A	1	1				6			2	11				1		1		1			24
A-		1				2			1	11							1				16
A+						3			3	14											20
B						2		1		22			4	1							30
B-						2				14	1	1	2								20
B+						4				13						1					18
C						3	1			9			1			1					15
C-				1		7				13	1		3		1	1					27
C+			1			4				11				1		1					18
D						2				15	1	1	1								20
D-						1				5	3										9
D+				1		2				16				1	1	2					23
F			1	1	1	15	1		2	53	4	1	3	1		4			1		88
NC						1															1
W			1			2				21	2		3			1					30
(blank)																					
Grand	1	2	3	3	1	56	2	1	8	228	12	3	17	5	2	12	1	1	1		359

L.1.4 2005:06 Grades

instructor term	major	Neal Young grade
05F	ENCS	A-
05F	IS	B+
05F	ENCS	A
05F	CEN	A+
05F	CEN	F
05F	ENCS	A
05F	ENCS	B+
05F	ENCS	C+
05F	CEN	A-
05F	ENCS	B-
05F	CEN	B+
05F	ENUN	B
05F	ENCS	B+
05F	IS	A+
05F	ENCS	B

instructor term	major	Neal Young grade
06W	ENCS	B
06W	CEN	A+
06W	CEN	B+
06W	IS	C+
06W	ENCS	B
06W	ENCS	A+
06W	ENCS	A-
06W	IS	A-
06W	ENCS	C
06W	ENCS	B-
06W	ENCS	A
06W	CEN	W
06W	ENCS	B+
06W	ENCS	B
06W	ENCS	B
06W	ENCS	A
06W	IS	B+
06W	ENCS	B+
06W	CEN	C-
06W	ENCS	A
06W	ENCS	A-
06W	ENCS	A-
06W	ENCS	A
06W	ENCS	C+
06W	ENCS	A-
06W	ENCS	A
06W	CEN	A-
06W	ENCS	A-

instructor term	major	Neal Young grade
06S	CEN	A-
06S	ENCS	A
06S	CEN	B
06S	ENCS	A
06S	ENCS	C
06S	CEN	B+
06S	ENCS	B-
06S	ELEN	A
06S	ENGL	B
06S	CEN	F
06S	CEN	B-
06S	ENCS	A-
06S	ENCS	C-
06S	CEN	A
06S	IS	A
06S	ENCS	B+
06S	CEN	C-
06S	ENUN	B
06S	CEN	A
06S	ENCS	C+
06S	CEN	A-
06S	ENCS	A-
06S	ENCS	C+
06S	ENCS	A-
06S	CEN	A
06S	ENCS	A-
06S	ENCS	B-

L.1.5 2005:06 Summary

Count of S	major							
grade	CEN	ELEN	ENCS	ENGL	ENUN	IS	(blank)	Grand Tota
A	3	1	9			1		14
A-	4		10			1		15
A+	2		1			1		4
B	1		5	1	2			9
B-	1		4					5
B+	3		5			2		10
C			2					2
C-	2		1					3
C+			4			1		5
F	2							2
W	1							1
(blank)								
Grand Tota	19	1	41	1	2	6		70

Appendix L: Assessment Driven Improvements

L.2 Course Materials Fees

TNP

RIVERSIDE: COLLEGE OF ENGINEERING
(909) 787-5190
(909) 787-3188 - FAX

To: France A. Cordova, Chancellor

Through: Gretchen S. Bolar, Vice Chancellor
Academic Planning and Budget

From: Satish K. Tripathi
Satish K. Tripathi, Dean
Bourns College of Engineering

cc: Lois Bell, Budget and Administrative Manager
Bourns College of Engineering

Matthew W. Hull, Assistant Vice Chancellor
Academic Planning and Budget

Date: April 14, 2004

Subject: Computer Science and Engineering Course Materials Fee Proposal

A Course Materials Fee (CMF) is being proposed by the Department of Computer Science and Engineering for laboratory courses to recover the costs of materials, supplies and equipment not covered by the normal instructional budget. Without the institution of this fee, increasing costs will force the department to either limit access to their computer laboratory courses or reduce the quality of the educational experience.

Bourns College of Engineering has conducted a comprehensive review of the proposal in compliance with the campus policy on CMF establishment. Academic Budget and Planning has been consulted, and an advisory committee was formed to review the proposal. The committee has unanimously recommended the establishment of a $20 fee for laboratory courses. A Computer Science graduate student on the committee enthusiastically supported the fee, stating it "would be considered a bargain by students," as it would help to insure the availability of state-of-the-art hardware, software and support materials. We have attached letters of support from the department ASUCR representative, Jeremy Harrison, from the officers of the UCR student branch of ACM, (Association for Computing Machinery) and from Thanh San D. Nguyen, a computer science major who served on the advisory committee.

Thank you for considering this request for CMF establishment. If you have any questions, please contact Manager Lois Bell at extension 8-5653.

UNIVERSITY OF CALIFORNIA--(Letterhead for interdepartmental use)

PROPOSAL TO ESTABLISH A NEW COURSE MATERIALS FEE
REQUEST FORM A

School/College: Bourns College of Engineering

Department/Program: Computer Science & Engineering

Proposed Fee Effective Date: 7/1/04

Department Contact: Pam Gunderson Ext: 8-5654

The Proposed Course Materials Fee will be charged to students enrolled in the following courses:

	Course	Number Labs	Number Quarters	Total labs per year	Enrollments 02-03 (Actual)	Enrollments 03-04 (Proj.)
1	CS005	2	3	6	116	168
2	CS008	16	3	48	1548	1610
3	CS010	9	3	27	680	700
4	CS012	5	3	15	346	392
5	CS014	4	3	12	264	280
6	CS061 (one qrtr has 5 labs)	4	3	13	329	364
7	CS100 (only 1 lab 02/03)	2	3	6	46	140
8	CS120B	1	3	3	53	84
9	CS122A	2	1	2	29	56
10	CS122B	1	1	1	20	28
11	CS130	2	2	4	149	112
12	CS133	3	1	3	64	84
13	CS141	5	3	15	359	392
14	CS152	3	3	9	198	224
15	CS153	3	3	9	221	280
16	CS160	1	1	1	12	28
17	CS161	3	3	9	225	252
18	CS162	1	1	1	11	28
19	CS164	3	3	9	152	252
20	CS165	2	1	2	41	56
21	CS166	4	2	8	168	196
22	CS168	1	1	1	84	28
23	CS170	3	1	3	57	84
24	CS177	1	1	1	25	28
25	CS179	2	3	6	224	240
26	CS180	2	2	4	74	112
27	CS181	2	2	4	122	140
28	CS183	2	1	2	61	56
				224	5678	6414

PROPOSAL TO ESTABLISH A NEW COURSE MATERIALS FEE
SAMPLE COSTING TABLE - FORM B

BOURNS COLLEGE OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course/Section/Lab (see A)	Enrollment HeadCount (see B)	2003 - 04 Expenditures by Category - Excluding Non-Inventorial Equipment (see C)						2003-04 Non-Inventory Equip.				
		Category 1 Paper	Category 2 Toner	Category 3 Software	Category 4 Software Upgrades	Category 5 Hardware Upgrades	Subtotal	Catetory 1* Computers	Category 2* Monitors	Category 3* Printers	Subtotal	TOTAL
CS005 (6 labs)	168	6,500	7,500	17,917	10,000	10,000	51,917	57,333	14,333	3,333	75,000	126,917
CS008 (48 labs)	1610											
CS010 (27 labs)	700											
CS012 (15 labs)	392											
CS014 (12 labs)	280											
CS061 (13 labs)	364											
CS100 (6 labs)	140											
CS120B (3 labs)	84											
CS122A (2 labs)	56											
CS122B (1 lab)	28											
CS130 (4 labs)	112											
CS133 (3 labs)	84											
CS141 (15 labs)	392											
CS152 (9 labs)	224											
CS153 (9 labs)	280											
CS160 (1 lab)	28											
CS161 (9 labs)	252											
CS162 (1 lab)	28											
CS164 (9 labs)	252											
CS165 (2 labs)	56											
CS166 (8 labs)	196											
CS168 (1 lab)	28											
CS170 (3 labs)	84											
CS177 (1 lab)	28											
CS179 (6 labs)	240											
CS180 (4 labs)	112											
CS181 (4 labs)	140											
CS183 (2 labs)	56											
TOTAL DEPARTMENT	6414	6,500	7,500	17,917	10,000	10,000	51,917	57,333	14,333	3,333	75,000	126,917

* Please see the attached spreadsheet showing the criteria used in determining the replacement intervals and unit costs for the various categories.

COST PER STUDENT: 19.79

TOTAL OF 224 COMPUTER LAB SECTIONS

TOTAL OF 6,414 STUDENTS FOR 2003

Description:

A: Use the appropriate level of costing groups, such as by class, section, or by lab, to outline the expenditures

B: Enrollment HeadCount - Total number of students enrolled in each cost groupings.

C: Expenditures - total expenditures as determined by object code expense or other category as maintained by the department. DO NOT include expenses for non-inventoriable equipment in this section.

D: Non-Inventoriable Equipment - Report expenses on the basis of annual depreciation over useful life; if not possible to determine the expenditures by each cost groupings the aggregate amount may be reported at the next lowest costing level.

COMPUTER SCIENCE & ENGINEERING
NON-INVENTORIAL EQUIPMENT
2003-04 EXPENDITURES WITH DEPRECIATION BY CATEGORY

CATEGORY	DESCRIPTION	QUANTITY	UNIT COST	LIFESPAN	COST PER YEAR
Category 1 - Computers	PC Computer with appropriate RAM and CPU, plus mouse, keyboard, floppy drive	215	800	3 years	**57,333.33**
Category 2 - Monitors	PC Monitor, 1280x1024 resolution, at least 17" screen	215	200	3 years	**14,333.33**
Category 3 - Printers	Networked, duplex, HP network printer	8	1250	3 years	**3,333.33**

OFFICE OF THE EXECUTIVE VICE CHANCELLOR AND PROVOST
RIVERSIDE, CALIFORNIA 92521

May 14, 2004

Satish K. Tripathi
Bourns College of Engineering

Dear Satish:

I am approving your request to establish Course Materials Fees (CMF) beginning Winter Quarter 2005 for the courses offered by the Department of Computer Science and Engineering listed on the schedule below. The corresponding fee must be charged consistently to all students enrolled in the applicable course, including all concurrently enrolled (University Extension) students. Under no circumstances are CMF waivers to be granted.

Course #	Course Title	CMF
CS 5	Introduction to Computer Programming	$20
CS 8	Introduction to Computing	$20
CS 10	Intro to Computer Sci. for Science, Mathematics, and Engineering	$20
CS 12	Intro to Computer Sci. for Science, Mathematics, and Engineering II	$20
CS 14	Introduction to Data Structures and Algorithms	$20
CS 61	Machine Organization and Assembly Language Programming	$20
CS 100	Software Construction	$20
CS 120B	Introduction to Embedded Systems	$20
CS 122A	Intermediate Embedded and Real-Time Systems	$20
CS 122B	Advanced Embedded and Real-Time Systems	$20
CS 130	Computer Graphics	$20
CS 133	Computational Geometry	$20
CS 141	Intermediate Data Structures and Algorithms	$20
CS 152	Compiler Design	$20
CS 153	Design of Operating Systems	$20
CS 160	Concurrent Programming and Parallel Systems	$20
CS 161	Design and Architecture of Computer Systems	$20
CS 162	Computer Architecture	$20
CS 164	Computer Networks	$20
CS 165	Computer Security	$20
CS 166	Database Management Systems	$20
CS 168	Introduction to Very Large Scale Integration (VLSI) Design	$20
CS 170	Introduction to Artificial Intelligence	$20
CS 177	Modeling and Simulation	$20
CS 179 E-Z	Project in Computer Science	$20
CS 180	Introduction to Software Engineer	$20
CS 181	Principles of Programming Languages	$20
CS 183	UNIX System Administration	$20

Please contact Assistant Vice Chancellor Matthew Hull to establish a fund number in the Student Fee series to record revenue and related expenditures. Revenue collected may only be used to fund expenditures that were included in the development of the specific CMF. In addition, the collection of CMF must be handled through the Campus Cashier in accordance with existing procedures and guidelines governing Student Fees, including the refund policy.

By copy of this letter, I am requesting Vice Chancellor James Sandoval to ensure that these fees are reflected in the Course Catalog and Schedule of Classes, and that they are included in the student budget used in determining financial aid awards.

While you as Dean may approve any CMF adjustments related to price increases, I would recommend that you consult with Academic Planning and Budget before implementing any such increase. Please note that any other change to CMF levels and the addition or deletion of a course require Chancellorial approval.

If you have any questions, please contact Assistant Vice Chancellor Matthew Hull in the Office of Academic Planning and Budget.

Sincerely,

Bill

William A. Jury
Interim Executive Vice Chancellor
and Provost

cc: Vice Chancellor Bolar
Vice Chancellor Sandoval
Chair Payne
Assistant Vice Chancellor Hull
Assistant Vice Chancellor McCracken
Finance and Administration Manager Bell

ACADEMIC PLANNING & BUDGET
RIVERSIDE, CALIFORNIA 92521

December 5, 2005

President Lizette Navarette
Associated Students

President Bryon Nuttall
Graduate Student Association

Dear Lizette and Bryon:

The Policy on Course Materials Fees (CMF), which was implemented in 1996-97, requires that an annual report of the CMF income and expenditures be distributed to the Associated Students (ASUCR) and the Graduate Student Association (GSA). Enclosed is the 2004-05 year-end financial reporting for the five departments (Biology, Biochemistry, Cell Biology and Neuroscience, Chemistry, Physics) in the College of Natural and Agricultural Sciences, the Art and Art History departments in the College of Humanities, Arts, and Social Sciences, and the Computer Sciences department in the Bourns College of Engineering charging CMF. Please note that all reports include revenue from summer 2005 enrollments, which will be expensed in fiscal year 2005-06.

College of Natural and Agricultural Sciences
As you can see from enclosed tables, the total funding available in fiscal year 2004-05 was $522,182. This includes a deficit of $6,793 carried forward from the prior year. The attached tables also outline how the CMF funds were spent in 2004-05 and that the fund had a year-end balance of $133,522. The year-end balance, which includes revenue for summer 2005, was carried forward and will be expended in 2005-06.

College of Humanities, Arts, and Social Sciences
In fiscal year 2003-04, the College included encumbrances in their expenditure report in error. Enclosed is a revised report for fiscal year 2003-04 which now excludes encumbered expenses.

As per the enclosed tables, the total funding available in fiscal year 2004-2005 for the Art and Art History departments was $27,685, which includes a carry forward of $5,581 from the prior year. The attached tables also outline how the CMF funds were spent in 2004-2005 and that the fund had a year-end balance of $5,142. The year-end balance, which includes revenue for summer 2005, was carried forward and will be expended in 2005-06.

Bourns College of Engineering
As you can see from enclosed tables, the total funding available in fiscal year 2004-05 was $60,942. The attached tables also outline how the CMF funds were spent in 2004-05 and that the fund had a year-end balance of $12,763. The year-end balance, which includes revenue for summer 2005, was carried forward and will be expended in 2005-06.

Please contact Principal Analyst Shelley Gupta at extension 22876 or by e-mail at shelley.gupta@ucr.edu if you have any questions regarding the enclosed tables.

Sincerely,

Matthew Hull
Assistant Vice Chancellor

Enclosures

cc: Vice Chancellor Bolar
Assistant Dean Carlson
Assistant Dean Hunter-Hancock
Assistant Dean Hartney
Principal Analyst Gupta

bcc: Principal Analyst Martinson
Management Services Officer Papavero
Senior Analyst Ripley

COURSE MATERIALS FEE
YEAR-END FINANCIAL REPORTING

2004-05 REVENUES BY CMF FUND

College/School: **BOURNS COLLEGE OF ENGINEERING - Computer Science & Engineering**
Date: 9/29/2005

CMF Fund	*Department*	*Course*	*CMF*	*Headcount Enrollment* UG	Grad	Total	***Total Revenue***	*Prior Year Carryforward*	*Total Funds Available*
20032	Computer Sciences	5	$20.00			98	$1,960	$0	$1,960
		6	$20.00			114	$2,280	$0	$2,280
		8	$20.00			1,162	$23,240	$0	$23,240
		10	$20.00			289	$5,780	$0	$5,780
		12	$20.00			153	$3,060	$0	$3,060
		14	$20.00			89	$1,780	$0	$1,780
		61	$20.00			146	$2,920	$0	$2,920
		100	$20.00			43	$860	$0	$860
		120B	$20.00			130	$2,600	$0	$2,600
		122A	$20.00			-	$0	$0	$0
		122B	$20.00			12	$240	$0	$240
		130	$20.00			27	$540	$0	$540
		133	$20.00			34	$680	$0	$680
		141	$20.00			50	$1,000	$0	$1,000
		152	$20.00			78	$1,560	$0	$1,560
		153	$20.00			113	$2,260	$0	$2,260
		160	$20.00			-	$0	$0	$0
		161	$20.00			59	$1,180	$0	$1,180
		162	$20.00			-	$0	$0	$0
		164	$20.00			51	$1,020	$0	$1,020
		165	$20.00			54	$1,080	$0	$1,080
		166	$20.00			73	$1,460	$0	$1,460
		168	$20.00			-	$0	$0	$0
		170	$20.00			70	$1,400	$0	$1,400
		177	$20.00			-	$0	$0	$0
		179 E-Z	$20.00			70	$1,400	$0	$1,400
		180	$20.00			33	$660	$0	$660
		181	$20.00			22	$440	$0	$440
		183	$20.00			30	$600	$0	$600
TotalComputer Sciences				-	-	3,000	$60,000	$0	$60,000
20032	STIP Revenue						$942	$0	$942
Total Unallocated				-	-	-	$942	$0	$942
Total fund 20032				-	-	-	**$60,942**	**$0**	**$60,942**

** Include enrollment and revenue data from cross-listed Electrical Engineering courses.

COURSE MATERIALS FEE
YEAR-END FINANCIAL REPORTING

2004-05 EXPENDITURES BY CMF FUND

College: **BOURNS COLLEGE OF ENGINEERING-Computer Science & Engineering**
Date: 29-Sep-05

CMF Fund	*Department*	*Funds Available*	*Expenditures by Category Excluding Non-Inventorial Equipment*						*Non-Inventory Equipment*	***Total Expenditures***	*Year End Balance*
			Goods & Services	*Supplies & Materials*	*Reproduce Supplemental Materials*	*Textbooks, Books, & Maps*	*Animal Goods, Suppls, & Materials*	*Supplemental Educational Experience*			
20032	Computer Sci **	$60,000	$537	601.03					$47,041	$48,179	$11,821
20032	Unallocated-STIP Revenue	$942								$0	$942
Total		$60,942	$537	$601	$0	$0	$0	$0	$47,041	$48,179	$12,763

** Include expenditure data from cross-listed Electrical Engineering courses.

Appendix L: Assessment Driven Improvements

L.3 Use of Debuggers in CS 14

L3.1 Programming Component Scores for Winter 2007

Winter 2007

	Prog Assn 1	Prog Assn 2	Prog Assn 3	Prog Assn 4	Prog Assn 5	Prog Assn %	Lab %	HW %	Quiz %	Midterm	Final
Average	70	52	69	64	52	61%	90%	56%	68%	74	70
1	0	0	0	0	0	0%	20%	25%	38%	68	59
2	20	0	0	0	0	4%	41%	17%	24%	41	31
3	30	0	0	0	0	6%	61%	20%	23%	52	32
4	30	90	0	0	0	24%	61%	25%	25%	46	0
5	40	36	61	0	0	27%	70%	37%	50%	55	28
6	30	41	61	0	50	36%	91%	58%	62%	59	57
7	30	38	68	0	50	37%	101%	58%	81%	79	70
8	75	31	53	71	0	46%	91%	42%	66%	64	40
9	79	0	82	84	0	49%	100%	82%	49%	63	64
10	80	0	87	70	40	55%	100%	37%	56%	75	95
11	10	70	70	79	53	56%	101%	25%	76%	74	58
12	30	70	70	92	21	57%	97%	40%	64%	74	66
13	99	70	87	0	33	58%	101%	70%	61%	72	59
14	70	25	70	81	50	59%	100%	60%	62%	72	72
15	70	0	78	70	83	60%	100%	45%	55%	81	88
16	20	75	70	96	57	64%	91%	7%	86%	89	70
17	99	31	91	70	30	64%	90%	55%	56%	69	59
18	99	70	53	81	25	66%	79%	48%	62%	91	67
19	92	43	74	80	57	69%	90%	87%	80%	84	77
20	99	43	70	70	81	73%	101%	52%	78%	95	73
21	99	64	62	85	62	74%	100%	53%	58%	57	62
22	70	74	83	66	83	75%	80%	52%	81%	69	61
23	70	43	82	92	100	77%	100%	75%	84%	75	82
24	99	70	92	63	83	81%	102%	68%	92%	80	82
25	99	100	81	66	76	84%	102%	88%	75%	73	90
26	99	49	97	89	96	86%	101%	87%	79%	77	83
27	73	96	100	82	85	87%	101%	65%	90%	100	90
28	95	77	83	107	77	88%	101%	75%	82%	76	88
29	99	70	89	116	65	88%	100%	93%	86%	87	91
30	99	48	95	116	85	89%	101%	92%	96%	92	92
31	100	85	76	84	98	89%	101%	70%	85%	84	88
32	100	100	97	79	68	89%	102%	52%	76%	73	87
33	95	100	100	116	96	101%	102%	95%	96%	109	101

L.3 Use of Debuggers in CS 14

L3.2 Programming Component Scores for Spring 2007

Spring 2007

	Prog Assn 1	Prog Assn 2	Prog Assn 3	Prog Assn 4	Prog Assn %	Lab %	HW %	Quiz %	Midterm	Final
Average	83	67	76	79	72%	102%	80%	71%	78	77
1	93	0	57	0	38%	72%	90%	26%	57	0
2	40	70	49	0	40%	90%	87%	74%	57	0
3	71	33	60	0	41%	101%	77%	71%	64	62
4	88	43	74	0	51%	109%	90%	74%	95	74
5	70	70	75	0	54%	109%	83%	48%	38	84
6	76	0	85	70	58%	100%	100%	79%	81	80
7	70	43	51	70	59%	105%	90%	79%	81	84
8	93	43	78	20	59%	102%	50%	56%	64	74
9	70	31	70	70	60%	101%	77%	45%	74	69
10	80	23	70	70	61%	104%	30%	100%	91	93
11	70	43	61	70	61%	104%	87%	75%	69	72
12	40	73	70	70	63%	100%	93%	53%	66	60
13	86	95	74	0	64%	93%	73%	76%	63	79
14	70	28	70	90	65%	100%	70%	51%	73	60
15	98	91	70	0	65%	104%	93%	57%	70	56
16	93	46	70	60	67%	101%	93%	59%	57	57
17	88	70	97	25	70%	104%	67%	82%	91	94
18	83	48	84	70	71%	101%	60%	43%	71	72
19	98	33	70	85	71%	101%	57%	86%	91	89
20	93	38	91	70	73%	101%	83%	60%	83	75
21	95	38	88	80	75%	92%	93%	90%	89	85
22	88	70	70	80	77%	104%	67%	89%	100	102
23	83	90	92	80	86%	108%	63%	91%	76	70
24	98	99	48	100	86%	101%	57%	69%	71	84
25	97	90	92	70	87%	100%	93%	82%	92	79
26	88	88	84	95	89%	101%	90%	70%	83	92
27	98	100	70	90	90%	101%	67%	66%	78	67
28	88	100	74	100	91%	104%	97%	87%	99	83
29	92	100	83	90	91%	104%	97%	79%	84	96
30	96	95	75	100	91%	108%	57%	64%	68	75
31	91	99	93	100	96%	102%	100%	69%	80	90
32	86	100	100	100	96%	100%	100%	77%	81	88
33	93	100	93	100	97%	104%	97%	93%	98	95
34	91	100	97	100	97%	109%	67%	79%	96	100
35	98	100	92	100	98%	108%	100%	81%	85	96

L3.3 Programming Component Scores for Fall 2007

Fall 2007

	Prog Assn 1	Prog Assn 2	Prog Assn 3	Prog Assn 4	Prog Assn 5	Prog Assn %	Lab %	HW %	Quiz %	Midterm	Final
Average	75	68	76	72	65	71%	97%	69%	64%	80	61
1	65	0	0	0	0	13%	46%	0%	11%	78	0
2	0	36	0	50	0	17%	98%	65%	44%	71	54
3	0	40	60	0	0	20%	41%	0%	11%	53	0
4	0	31	42	50	0	25%	102%	45%	40%	79	43
5	0	0	55	58	15	26%	103%	55%	33%	59	47
6	28	43	37	0	40	30%	91%	58%	51%	74	0
7	62	91	90	0	85	66%	104%	40%	40%	73	73
8	82	27	77	95	80	72%	102%	85%	53%	75	67
9	90	89	82	95	45	80%	102%	60%	70%	74	88
10	100	83	63	84	90	84%	103%	53%	75%	76	57
11	95	26	109	94	100	85%	103%	93%	88%	81	94
12	100	89	70	92	75	85%	103%	88%	46%	81	60
13	100	79	103	92	70	89%	102%	73%	85%	93	72
14	100	76	95	82	100	91%	104%	78%	61%	76	64
15	97	98	73	95	95	92%	103%	90%	98%	98	100
16	106	85	92	98	80	92%	102%	88%	74%	62	0
17	97	97	98	91	80	93%	102%	85%	85%	102	88
18	100	98	104	100	65	93%	103%	90%	76%	100	71
19	106	93	104	97	80	96%	108%	75%	83%	79	77
20	100	91	101	94	95	96%	103%	98%	70%	75	73
21	95	90	102	100	100	97%	103%	95%	103%	92	97
22	100	100	104	94	100	100%	103%	83%	91%	94	91
23	106	95	97	100	100	100%	103%	98%	86%	96	96

L3.4 Programming Component Scores for Winter 2008

Winter 2008

	Prog Assn 1	Prog Assn 2	Prog Assn 3	Prog Assn 4	Prog Assn %	Lab %	HW %	Quiz %	Midterm	Final
Average	86	65	73	71	74%	96%	69%	71%	79	79
1	0	0	37	50	22%	99%	81%	27%	80	76
2	65	60	0	0	31%	72%	0%	39%	66	0
3	79	50	0	0	32%	81%	44%	42%	63	0
4	70	0	0	100	43%	100%	96%	65%	72	78
5	95	75	10	0	45%	80%	19%	64%	62	46
6	99	0	89	0	47%	101%	81%	66%	60	60
7	84	45	71	0	50%	71%	41%	41%	59	0
8	4	55	71	70	50%	101%	96%	63%	75	65
9	88	55	62	0	51%	98%	30%	52%	75	0
10	78	100	52	0	58%	102%	15%	36%	67	0
11	78	70	83	0	58%	99%	37%	87%	88	99
12	89	0	65	100	64%	92%	89%	42%	72	80
13	68	55	96	50	67%	101%	100%	77%	84	71
14	95	0	82	100	69%	50%	0%	82%	58	0
15	99	50	100	35	71%	102%	93%	87%	69	73
16	83	60	61	100	76%	97%	85%	76%	59	76
17	95	55	78	90	80%	101%	93%	89%	80	71
18	70	70	97	90	82%	101%	78%	81%	74	73
19	99	65	72	100	84%	98%	104%	68%	83	73
20	76	100	71	100	87%	100%	0%	10%	78	65
21	97	70	88	100	89%	103%	89%	82%	84	80
22	97	85	84	90	89%	100%	67%	51%	80	84
23	98	80	81	100	90%	101%	26%	82%	88	81
24	100	100	62	100	91%	101%	33%	94%	95	92
25	95	100	76	100	93%	101%	81%	95%	96	96
26	101	80	95	100	94%	99%	96%	84%	83	91
27	103	75	98	100	94%	103%	85%	85%	81	79
28	102	80	97	100	95%	100%	85%	66%	74	63
29	104	72	107	100	96%	103%	100%	92%	90	86
30	101	90	96	100	97%	101%	100%	90%	89	80
31	100	100	88	100	97%	100%	100%	83%	101	97
32	104	100	88	100	98%	102%	100%	107%	104	106
33	100	90	105	100	99%	104%	115%	99%	99	79
34	106	100	94	100	100%	102%	59%	94%	92	92
35	106	100	103	100	102%	102%	100%	93%	92	76

Appendix L: Assessment Driven Improvements

L.4 Establishment of CS 180

L.4 Proposal to Create CS 180

Course Request and Maintenance System

ENGR 180, 06/16/2008, 07:43 AM
LISAGU_P_ENGR (Lisa Guethlein)

Course Approval Form
(Approved)

Coll./Schl./Div.:	College of Engineering
Dept./Comm./Prog.:	College of Engineering
Action:	NEW
Course Level:	Undergraduate Course
Course Type:	Standard Course
Effective:	Fall 2004
Offered once only:	No
Offered summer sessions only:	No
Quarter(s) Offered:	Fall, Spring
Last Approved Form Effective:	(Submitted:)
Notes:	

	Proposed
Course Number:	ENGR 180
Renumbered From:	
Course Title:	Technical Communications
E-Z Segment Title:	
Units:	3
Activity(ies):	Lecture, 2 hours per week (group activity) Workshop, 3 hours per week (group activity)
Prerequisite(s):	ENGL 001C or ENGL 01SC; upper-division standing
Description:	Develops oral, written, and graphical communication skills needed by scientists and engineers. Topics include giving oral presentations, working in small groups, and preparing and critiquing reports, proposals, instructions, and business correspondence. Workshop involves extensive oral presentations, communication in small groups, and written projects.
Grading Type:	Letter Grade or petition for Satisfactory/No Credit (S/NC)
In Progress:	No

Statement:

Repeatable: No

Maximum Units:

Statement:

Cross-listed With:

Credit Statement:

If repeatable, may be taken more than once per quarter: No

Breadth Statement:

Instructor(s): Professor Mark Matsumoto in charge

Justification:

Surveys of employers increasingly indicate that effective communication skills are a critical requirement for success in engineering and scientific fields, yet those skills are sorely lacking among college graduates. Our own experiences with our senior students indicate that their communication skills are not sufficient. Numerous engineering programs now offer such courses (e.g., USC, Georgia Tech, Wisconsin, to name just a few). While students currently take English 1 A, B and C (and even 1SC, designed for scientists and engineers), the proposed course is upper-division and intended to develop more advanced skills in light of the student's more advanced technical knowledge. Furthermore, a key to effective communication is extensive practice - the proposed course's workshop will provide plenty of opportunity for students to give talks, work in small groups, write, and critique.

Correspondence:

Overlaps/Duplicates Other Courses: No

Affects Programs: This course will be a requirement for Computer Science and for Information Systems.

Affects Prerequisites/Descriptions: No

Syllabus:

Book: The MIT Guide to Science and Engineering Communication, James G. Paradis, Muriel Zimmermann, 1997, MIT Press.

Topics: Importance of communication in science and engineering, defining an audience, organizing and drafting documents, revising for organization and style, developing graphics, conducting

Book: The MIT Guide to Science and Engineering Communication, James G. Paradis, Muriel Zimmermann, 1997, MIT Press.

Topics: Importance of communication in science and engineering, defining an audience, organizing and drafting documents, revising for organization and style, developing graphics, conducting

meetings, memos/letters/email, proposals, progress reports, articles, instructions and procedures, electronic text, oral presentations, job search documents.

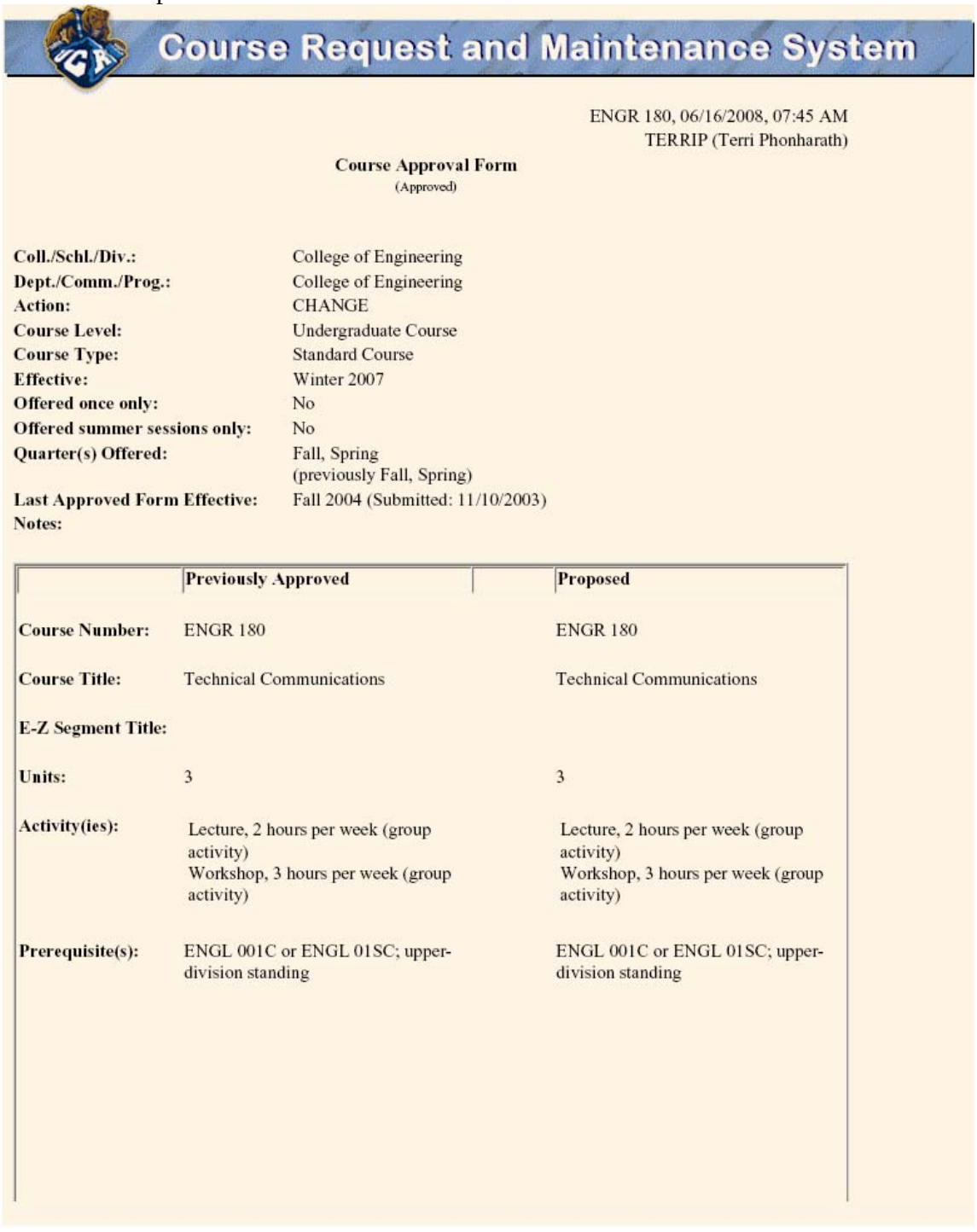
Workshop activities: oral presentations (with and without graphical aids), small group meetings (leading and non-leading roles), group problem solving, critiquing written and oral presentations.

Grade: 40% written exams covering theory and writing, 10% homework, 30% presentations, 20% participation.

Approvals:		
Department/Committee/Program Faculty:		11/07/2003
Submitted by Department/Committee/Program Chair:	Mark Matsumoto	11/07/2003
Reviewed by Courses Office:	Cheri Schillreff	11/18/2003
Reviewed by Dean of College/School/Division:		
Executive Committee College of Engineering:	Mart Molle	11/26/2003
College of Humanities, Arts, and Social Sciences:		
College of Natural and Agricultural Sciences:		
Division of Biomedical Sciences:		
Graduate School of Education:		
Graduate School of Management:		
University Honors Program:		
Dean of the Graduate Division:		
Graduate Council:		
Committee on Courses:	D. A. DEMASON	12/11/2003

L.4 Establishment of CS 180

L.4 Proposal to Revise CS 180



Course Request and Maintenance System

ENGR 180, 06/16/2008, 07:45 AM
TERRIP (Terri Phonharath)

Course Approval Form
(Approved)

Coll./Schl./Div.:	College of Engineering
Dept./Comm./Prog.:	College of Engineering
Action:	CHANGE
Course Level:	Undergraduate Course
Course Type:	Standard Course
Effective:	Winter 2007
Offered once only:	No
Offered summer sessions only:	No
Quarter(s) Offered:	Fall, Spring (previously Fall, Spring)
Last Approved Form Effective:	Fall 2004 (Submitted: 11/10/2003)
Notes:	

	Previously Approved	**Proposed**
Course Number:	ENGR 180	ENGR 180
Course Title:	Technical Communications	Technical Communications
E-Z Segment Title:		
Units:	3	3
Activity(ies):	Lecture, 2 hours per week (group activity) Workshop, 3 hours per week (group activity)	Lecture, 2 hours per week (group activity) Workshop, 3 hours per week (group activity)
Prerequisite(s):	ENGL 001C or ENGL 01SC; upper-division standing	ENGL 001C or ENGL 01SC; upper-division standing

Description:	Develops oral, written, and graphical communication skills needed by scientists and engineers. Topics include giving oral presentations, working in small groups, and preparing and critiquing reports, proposals, instructions, and business correspondence. Workshop involves extensive oral presentations, communication in small groups, and written projects.	Develops oral, written, and graphical communication skills. Involves extensive oral communication and presentations in small groups, and preparing and critiquing reports, proposals, instructions, and business correspondence. Emphasizes professional and ethical responsibilities and the need to stay current on technology and its global impact on economics, society, and the environment. Justification: Added ethics to the description per ABET criteria. The beginning of the description was rewritten to emphasize that this course covers ABET's f-j out comes.
Grading		
Type:	Letter Grade or petition for Satisfactory/No Credit (S/NC)	Letter Grade or petition for Satisfactory/No Credit (S/NC)
In Progress:	No	No
Statement:		
Repeatable:	No	No
Maximum Units:		
Statement:		
Cross-listed With:		
Credit Statement:		

If repeatable, may be taken more than once per quarter:	No (previously No)
Breadth Statement:	
Instructor(s):	Professor Mark Matsumoto in charge

Justification:

Correspondence:

Overlaps/Duplicates Other Courses:	No

Affects Programs: No

Affects Prerequisites/Descriptions: No

Syllabus:

Book: The MIT Guide to Science and Engineering Communication, James G. Paradis, Muriel Zimmermann, 1997, MIT Press.

Topics: Importance of communication in science and engineering, defining an audience, organizing and drafting documents, revising for organization and style, developing graphics, conducting meetings, memos/letters/email, proposals, progress reports, articles, instructions and procedures, electronic text, oral presentations, job search documents. Will also emphasis professional and ethical responsibilities.

Workshop activities: oral presentations (with and without graphical aids), small group meetings (leading and non-leading roles), group problem solving, critiquing written and oral presentations.

Grade: 40% written exams covering theory and writing, 10% homework, 30% presentations, 20% participation.

I. Writing for Business
Week 1. Introduction to Eng 180
A. Lecture (T) Intro
B. Lecture (TH) The Writing Process
C. Lab (Both) Language Arts Diagnostics & Resumes
Week 2. Logic & Persuasion
A. Lecture (T) Inductive Reasoning and Business
B. Lecture (TH) Deductive Reasoning and Business
C. Lab (Both) Diagramming and Truth Tables
Week 3. Reporting and Presentations
A. Lecture (T) Presentation Style: Slides & Handouts
B. Lecture (TH) Presentation Skills: Talking to People
C. Lab (Both) Unit I Final Project
Unit II. Writing for Engineers
Week 4. Audience
A. Lecture (T) VARK/Personas
B. Lecture (TH) Use Cases/Scenarios
C. Lab (Both) Persona & Scenario Writing
Week 5. Writing for Your Audience
A. Lecture (T) Outlining, Mind Maps, and Document to the Question
B. Lecture (TH) Grammar & Style
C. Lab (Both) Outlining a Spec
Week 6. Writing Functional Specs
A. Lecture (T) Elements of a Specification, Part I
B. Lecture (TH) Elements of a Specification, Part II
C. Lab (Both) Unit II Final Project: Functional Spec drafts
Unit III. Writing for End Users
Week 7. Usability
A. Lecture (T) What is Usability
B. Lecture (TH) Usability Walkabout
C. Lab (Both) Drafting & Alpha Doc Test
Week 8. Writing for Your Audience, Redux
A. Lecture (T) Explanations & Simplification, Part I
B. Lecture (TH) Explanations & Simplification, Part II
C. Lab (Both) Revising & Beta Doc Test

Week 9. Design
A. Lecture (T) Visual Gestalt & Page Layout
B. Lecture (TH) Designing for Online Use
C. Lab (Both) Unit II Final: Paper Airplane, revised
Unit IV. Review for Final
Week 10. Review
A. Lecture (T) Bonni?s Review of Important Material
B. Lecture (TH) Sharon?s Review of Important Material
C. Lab (Both) Follow-Up Questions to Review & ?Study Hall?

Approvals:		
Department/Committee/Program Faculty:		05/05/2006
Submitted by Department/Committee/Program Chair:	Thomas Payne	05/05/2006
Reviewed by Courses Office:	Cheri Schillreff	05/24/2006
Reviewed by Dean of College/School/Division:		
Executive Committee		
College of Engineering:	Akula Venkatram	05/31/2006
College of Humanities, Arts, and Social Sciences:		
College of Natural and Agricultural Sciences:		
Division of Biomedical Sciences:		
Graduate School of Education:		
Graduate School of Management:		
University Honors Program:		
Dean of the Graduate Division:		
Graduate Council:		
Committee on Courses:	G. E. HAGGERTY	06/09/2006