Program Self-Study Report

for

BS and MS in Computer Engineering Programs
BS and MS in Software Engineering Programs

Submitted by:

College of Engineering
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To

The Program Planning Review Committee
San Jose State University,
San Jose, CA 95192
Table of Contents

A. EXECUTIVE SUMMARY ...........................................................................................................................................1

A.1 DEGREE TITLES ......................................................................................................................................................1
A.2 CONTACT INFORMATION .....................................................................................................................................1
A.3 PROGRAM PLANNING REVIEW SUMMARY .......................................................................................................1
A.4 PROGRAM PLANNING AND STRATEGIES SUMMARY .......................................................................................2

B. PROGRAM PLANNING REVIEW REPORT ...........................................................................................................3

B.1 LAST PROGRAM PLANNING REVIEW ...............................................................................................................3

B.1.1 BS in CMPE ......................................................................................................................................................3
  B.1.1.1 Fall 1999 Review .......................................................................................................................................3
  B.1.1.1.1 Curricular Changes ...............................................................................................................................6
  B.1.1.1.2 Content Changes ..................................................................................................................................6
  B.1.1.1.3 Other Changes .......................................................................................................................................7
  B.1.1.1.4 Faculty Assessment .............................................................................................................................7
  B.1.1.2 Spring 2006 Review ..................................................................................................................................8
    B.1.1.2.1 Spring 2006 ABET Final Report ........................................................................................................8
    (End quote?) .........................................................................................................................................................9
  B.1.1.2.2 Program Change Activities ..................................................................................................................9

B.1.2 MS in CMPE – Spring 2005 Review ..................................................................................................................11
  B.1.2.1 External Reviewer’s Report .....................................................................................................................11
  B.1.2.2 Department Response ................................................................................................................................16
  B.1.2.3 College of Engineering Assessment ......................................................................................................17
  B.1.2.4 Program Change Activities ...................................................................................................................19

B.2 PROGRAM PLANNING OVERVIEW ..................................................................................................................20

B.2.1 Assessment Life-Cycle Processes ..................................................................................................................20
  B.2.1.1 BS in CMPE and BS in SE .....................................................................................................................20
  B.2.1.2 MS in CMPE and MS in SE .....................................................................................................................21

B.2.2 Assessment Life-Cycle Matrix .......................................................................................................................22
  B.2.2.1 BS in CMPE ..........................................................................................................................................22
  B.2.2.2 MS in CMPE ..........................................................................................................................................22
  B.2.2.3 BS in SE ...............................................................................................................................................23
  B.2.2.4 MS in SE ...............................................................................................................................................23

B.3 STUDENTS ............................................................................................................................................................23

B.3.1 Student Enrollment for the Last Five Years and Projection ...........................................................................23

B.3.2 Student Sources ................................................................................................................................................24
  B.3.2.1 BS in CMPE and BS in SE .......................................................................................................................24
    B.3.2.1.1 Lower Division Entry ...........................................................................................................................25
    B.3.2.1.2 Upper Division Entry ..........................................................................................................................25
    B.3.2.1.3 Evaluation of Transfer Credit ............................................................................................................25
    B.3.2.1.4 Internal Transfers ...............................................................................................................................26
  B.3.2.2 MS in CMPE and MS in SE .....................................................................................................................26
    B.3.2.2.1 Process for Acceptance of New Students .........................................................................................26
    B.3.2.2.2 Internal Transfer Students ..................................................................................................................27

B.3.3 Program Orientation for New Students .........................................................................................................27
  B.3.3.1 BS in CMPE and BS in SE .......................................................................................................................27
  B.3.3.2 MS in CMPE and MS in SE .....................................................................................................................27

B.3.4 Advising ...........................................................................................................................................................27
  B.3.4.1 BS in CMPE and BS in SE .......................................................................................................................27
  B.3.4.2 MS in CMPE and MS in SE .....................................................................................................................28

B.3.5 Monitoring Student Performance ..................................................................................................................29
  B.3.5.1 BS in CMPE and BS in SE .......................................................................................................................29
  B.3.5.2 MS in CMPE and MS in SE .....................................................................................................................29

B.3.6 Process to Ensure All Students Meet All Program Requirements ...............................................................29
  B.3.6.1 BS in CMPE and BS in SE .......................................................................................................................29
  B.3.6.2 MS in CMPE and MS in SE .....................................................................................................................30

B.4 PROGRAM EDUCATIONAL OBJECTIVES .......................................................................................................30

Self-Study Report v8.doc
# TABLE OF CONTENTS

**B.4.1 Constituencies** ................................................................................................................................. 30  
**B.4.2 Program Mission** ................................................................................................................................. 30  
  B.4.2.1 BS in CMPE ........................................................................................................................................... 30  
  B.4.2.2 MS in CMPE ........................................................................................................................................... 31  
  B.4.2.3 BS in SE ................................................................................................................................................ 31  
  B.4.2.4 MS in SE ................................................................................................................................................ 31  
**B.4.3 Program Educational Objectives for Undergraduate Programs** ............................................................ 32  
  B.4.3.1 BS in CMPE ........................................................................................................................................... 32  
  B.4.3.2 BS in SE ................................................................................................................................................ 32  
**B.4.4 Program Outcomes for Graduate Programs** .......................................................................................... 32  
  B.4.4.1 MS in CMPE ........................................................................................................................................... 32  
  B.4.4.2 MS in SE ................................................................................................................................................ 33  
**B.4.5 Assessment of Program Objectives** .................................................................................................... 34  
  B.4.5.1 BS in CMPE and BS in SE ...................................................................................................................... 34  
    B.4.5.1.1 The process of formulating and Reviewing the Program Educational objectives .......................... 34  
    B.4.5.1.2 Achieving the Program Educational Objectives ............................................................................. 37  
    B.4.5.1.3 The Relationship between Program Outcomes and Program Educational Objectives .............. 37  
    B.4.5.1.4 Evaluating Program Educational Objectives for Achievement .................................................... 38  
    B.4.5.1.4.1 Alumni Surveys ............................................................................................................................... 40  
    B.4.5.1.4.2 Employer Survey ........................................................................................................................... 41  
    B.4.5.1.4.3 Program Outcome Assessment .................................................................................................. 42  
    B.4.5.1.4.4 Overall Evaluation of Program’s Ability to Achieve Program Educational Objectives .............. 42  
**B.5 PROGRAM OUTCOMES AND ASSESSMENT** .......................................................................................... 44  
**B.5.1 Curriculum and Professional Component** .......................................................................................... 44  
  B.5.1.1 BS in CMPE ........................................................................................................................................... 44  
    B.5.1.1.1 Program Review ............................................................................................................................... 44  
    B.5.1.1.2 Curriculum Content ....................................................................................................................... 44  
    B.5.1.1.3 Preparation for Engineering Practice ............................................................................................ 46  
  B.5.1.2 MS in CMPE ........................................................................................................................................... 47  
    B.5.1.2.1 Program Review ............................................................................................................................... 47  
    B.5.1.2.2 Curriculum Content ....................................................................................................................... 47  
    B.5.1.2.3 Preparation for Engineering Practice ............................................................................................ 48  
  B.5.1.3 BS in SE Program .................................................................................................................................. 48  
    B.5.1.3.1 Program Review ............................................................................................................................... 48  
    B.5.1.3.2 Curriculum Content ....................................................................................................................... 49  
    B.5.1.3.3 Preparation for Engineering Practice ............................................................................................ 50  
**B.5.2 Program Outcomes and Assessment for BS in CMPE** ........................................................................... 53  
  B.5.2.1 Program Outcomes ............................................................................................................................... 53  
  B.5.2.2 Program Outcomes Assessment .......................................................................................................... 53  
    B.5.2.2.1 Assessment Process ........................................................................................................................ 55  
    B.5.2.2.3 Assessment of the Technical Curriculum by Program Faculty ...................................................... 57  
      B.5.2.2.3.1 Course Journal ........................................................................................................................... 57  
      B.5.2.2.3.1.1 Course Description ................................................................................................................ 57  
      B.5.2.2.3.1.2 Course Modifications .............................................................................................................. 58  
      B.5.2.2.3.1.3 Course Assessment ............................................................................................................... 58  
      B.5.2.2.3.1.4 Assessment Data ................................................................................................................... 58  
    B.5.2.2.3.2 Outcome Report ........................................................................................................................ 58  
      B.5.2.2.3.2.1 Operational Definition of the Outcome .................................................................................. 59  
      B.5.2.2.3.2.2 Curriculum Progression towards the Outcome .................................................................... 59  
      B.5.2.2.3.2.3 Course to Program Outcome Assessment .......................................................................... 59  
      B.5.2.2.3.2.4 Outcome Assessment and Recommended Actions .................................................................. 59  
    B.5.2.2.3.5 Basis for Assessment ................................................................................................................ 59  
    B.5.2.2.3.3 Status of the Assessment Process ............................................................................................... 60  
  B.5.2.4 Assessment of the Technical Curriculum by Industry Representatives ................................................. 60  
  B.5.2.5 Laboratory Assessment ...................................................................................................................... 60  
  B.5.2.6 Assessment of General Education ...................................................................................................... 60  
    B.5.2.6.1 General Education Contributions to Engineering Outcomes ....................................................... 60  
    B.5.2.6.2 General Goals of Advanced GE .................................................................................................. 61  
    B.5.2.6.3 Course Certification and Assessment ........................................................................................... 62  
**B.5.3 Program Outcomes for MS in CMPE** .................................................................................................... 63  
  B.5.3.1 Assessment Coverage ....................................................................................................................... 63  

---

Self-Study Report v8.doc
### TABLE OF CONTENTS

B.5.3.2 Course Assessment .................................................................................................................. 63
B.5.3.3 Student Exit Survey .................................................................................................................... 69
B.5.3.4 Advisory Council Input .............................................................................................................. 69
  B.5.3.4.1 Advisory Council Input Assessment Questions ................................................................. 69
  B.5.3.4.2 Advisory Council Input Assessment Results ................................................................. 70
B.5.3.5 Alumni Survey ......................................................................................................................... 70
  B.5.3.5.1 Alumni Survey Questions .................................................................................................. 70
  B.5.3.5.1 Alumni Survey Results .................................................................................................... 71
B.5.3.6 Employer Survey .................................................................................................................... 72
  B.5.3.6.1 Employer Survey Questions ............................................................................................ 72
  B.5.3.6.2 Employer Survey Results ................................................................................................ 73

B.5.4 Program Outcomes and Assessment for BS in SE ..................................................................... 74
  B.5.4.1 Program Outcomes .................................................................................................................. 74
  B.5.4.2 Program Outcomes Assessment ............................................................................................. 74
  B.5.4.2.1 Assessment Process ............................................................................................................ 76
B.5.4.3 Assessment of the Technical Curriculum by Program Faculty .................................................. 78
  B.5.4.3.1 Course Journal .................................................................................................................... 78
    B.5.4.3.1.1 Course Description ........................................................................................................ 78
    B.5.4.3.1.2 Course Modifications .................................................................................................... 79
    B.5.4.3.1.3 Course Assessment ....................................................................................................... 79
    B.5.4.3.1.4 Assessment Data ......................................................................................................... 79
  B.5.4.3.2 Outcome Report ................................................................................................................ 79
    B.5.4.3.2.1 Operational Definition of the Outcome ........................................................................ 80
    B.5.4.3.2.2 Curriculum Progression towards the Outcome ............................................................ 80
    B.5.4.3.2.3 Course to Program Outcome Assessment ................................................................. 80
    B.5.4.3.2.4 Outcome Assessment and Recommended Actions ...................................................... 80
    B.5.4.3.2.5 Basis for Assessment .................................................................................................. 80
  B.5.4.3.3 Status of the Assessment Process ......................................................................................... 81
B.5.4.4 Assessment of the Technical Curriculum by Industry Representatives .................................. 81
B.5.4.5 Laboratory Assessment .......................................................................................................... 81
B.5.4.6 Assessment of General Education ............................................................................................ 81
  B.5.4.6.1 General Education Contributions to Engineering Outcomes ............................................ 81
  B.5.4.6.2 General Goals of Advanced GE ........................................................................................ 82
  B.5.4.6.3 Course Certification and Assessment .................................................................................. 83

B.5.5 Program Outcomes for MS in SE .............................................................................................. 84
  B.5.5.1 Assessment Coverage ........................................................................................................... 84
  B.5.5.2 Course Assessment ................................................................................................................ 84
  B.5.5.3 Student Exit Survey .............................................................................................................. 87
  B.5.5.4 Advisory Council Input ........................................................................................................ 88
  B.5.5.5 Alumni Survey ....................................................................................................................... 89
    B.5.5.5.1 Alumni Survey Questions ............................................................................................... 89
    B.5.5.5.2 Alumni Survey Responses .............................................................................................. 90
  B.5.5.6 Employer Survey .................................................................................................................. 90
    B.5.5.6.1 Employer Survey Questions ............................................................................................ 90
    B.5.5.6.2 Employer Survey Responses .......................................................................................... 91

B.6 DATA ANALYSIS AND RECOMMENDATIONS FOR IMPROVEMENT .................................. 93

B.6.1 BS in CMPE ............................................................................................................................... 93
  B.6.1.1 Outcome reports .................................................................................................................... 93
  B.6.1.2 Course Based Assessment – Student Work and Student Feedback ...................................... 95
  B.6.1.3 Junior and senior surveys ...................................................................................................... 96
  B.6.1.4 Nationally Normed Exit Survey (EBI) .................................................................................. 97
  B.6.1.5 Senior Projects ...................................................................................................................... 98
  B.6.1.6 Graduating Students Focus Groups ...................................................................................... 98
  B.6.1.7 Employer Survey .................................................................................................................. 99
  B.6.1.8 Assessment Results .............................................................................................................. 99
    B.6.1.8.1 Program Outcome a .......................................................................................................... 99
    B.6.1.8.2 Program Outcome b .......................................................................................................... 102
    B.6.1.8.3 Program Outcome c .......................................................................................................... 105
    B.6.1.8.4 Program Outcome d .......................................................................................................... 110
    B.6.1.8.5 Program Outcome e .......................................................................................................... 114
    B.6.1.8.6 Program Outcome f .......................................................................................................... 118
    B.6.1.8.7 Program Outcome g .......................................................................................................... 119
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. PROGRAM PLANNING AND STRATEGIES</td>
<td>151</td>
</tr>
<tr>
<td>C.1 Strategies and Actions Plan</td>
<td>151</td>
</tr>
<tr>
<td>C.1.1 Goal 1 – Improve the quality of student learning</td>
<td>151</td>
</tr>
<tr>
<td>C.1.1.1 Objective 1 – Complete BS in SE assessment cycle in 2008</td>
<td>151</td>
</tr>
<tr>
<td>C.1.1.2 Objective 2 – Focus support for the specializations of the programs</td>
<td>151</td>
</tr>
<tr>
<td>C.1.1.3 Objective 3 – Coordinate offerings with and recruitment from community colleges</td>
<td>151</td>
</tr>
<tr>
<td>C.1.1.4 Objective 4 – To implement the closer integration of the BS and MS degrees allowed by the change in CSU policy with respect to co-terminal degree programs</td>
<td>152</td>
</tr>
<tr>
<td>C.1.1.5 Objective 5 – Graduate students with a multicultural and global professional perspective</td>
<td>152</td>
</tr>
<tr>
<td>C.1.2 Goal 2: To continue to strengthen our broadly connected learning and research environment</td>
<td>152</td>
</tr>
<tr>
<td>C.1.2.1 Objective 1 – Develop curricular support for the interplay of computer and mechanical engineering</td>
<td>153</td>
</tr>
<tr>
<td>C.1.2.2 Objective 2 – Develop curricular support for educating the broader student population about the interplay of technology and policy</td>
<td>153</td>
</tr>
<tr>
<td>C.2 FIVE YEAR FACULTY AND STAFF HIRING PLAN</td>
<td>154</td>
</tr>
<tr>
<td>C.2.1 Faculty Hiring Plan and Justification</td>
<td>154</td>
</tr>
<tr>
<td>C.2.2 Staff Hiring Plan and Justification</td>
<td>158</td>
</tr>
</tbody>
</table>
A. EXECUTIVE SUMMARY
A.1 Degree Titles
The Computer Engineering Department offers four programs of study which leads to the degrees of Bachelor of Science in Computer Engineering, Master of Science in Computer Engineering, Bachelor of Science in Software Engineering, Master of Science in Software Engineering.

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A.3 Program Planning Review Summary
The Computer Engineering Department hosts four degree programs – Bachelor of Science in Computer Engineering (BS in CMPE), Master of Science in Computer Engineering (MS in CMPE), Bachelor of Science in Software Engineering (BS in SE), and Master of Science in Software Engineering (MS in SE). The BS in SE program is jointly administrated by the Computer Engineering Department and Computer Science Department.

Given the mission of the Computer Engineering Department, the program outcomes of these four programs were developed and revised with extensive input from the Department Advisory Council (DAC). The program outcomes are regularly assessed by the DAC, employers of the graduates, and through assessment of outcomes of the program. The program outcomes are assessed indirectly (administering various types of surveys) and directly (senior exit written and oral exams) by the various constituencies of the program. The BS SE program is still in its infancy, and the assessment processes are primarily at the curriculum architecture level, with course level assessment to commence Spring 2007.

Section B.2 summarizes the assessment life-cycle processes and matrix for assessment of the program outcomes and objectives. In Sections B.4 and B.5 the program outcomes and an assessment processes and results of the objectives and outcomes assessments are summarized. As seen from Sections B.4 and B.5, each program has a systematic process in place for the evaluation of how well the objectives and outcomes are met. Assessment data has been analyzed and recommendations for improvement are described in Section B.6. Through this process evaluation several changes have been implemented by developing new courses, making changes in the existing courses at both the undergraduate and graduate levels since last program planning review. Since last program review, the program activities changes for BS in CMPE and MS in CMPE are summarized in Section B.1.
Since it has been a relatively short time since the department last closed the assessment cycle for the programs (AY 2005-06 for the BS and MS CMPE programs), or they are very young (the BS and MS SE programs commenced fall 2004) there are fairly few changes to report since the previous checkpoint. – the department is in the process of implementing the improvements suggested by the recent assessments.

A.4 Program Planning and Strategies Summary

In Section C of this report, program planning components are described in detail, and the strategic goals and their action plans are presented. In addition, a five year faculty and staff hiring plan is presented.

The Computer Engineering Department has identified two overarching goals (based on feedback received from various constituencies of the department’s programs) with the corresponding objectives. These goals with the objectives are briefly summarized below.

Goal 1 – To improve the quality of student learning

  Objective 1 – Complete BS in SE assessment cycle in 2008
  Objective 2 – Focus support for the specializations of the programs
  Objective 3 – Coordinate offerings with and recruitment from community colleges
  Objective 4 – Implement the closer integration of the BS and MS degrees allowed by the change in CSU policy with respect to co-terminal degree programs
  Objective 5 – Graduate students with a multicultural and global professional perspective

Goal 2 – To continue to strengthen our broadly connected learning and research environment.

  Objective 1 – Develop curricular support for the interplay of computer and mechanical engineering
  Objective 2 – Develop curricular support for educating the broader student population about the interplay of technology and policy
B. PROGRAM PLANNING REVIEW REPORT

B.1 Last Program Planning Review

The four degree programs of the department are subject to different review and accreditation cycles. The BS CMPE degree is ABET accredited, and completed its most recent cycle spring 2006 (with a full 6-year accreditation – the maximum possible), the MS CMPE degree program is subject to SJSU internal review, and completed its previous review the AY 2005-06. The BS and MS SE programs are new, and have only recently started admitting students.

Consequently we will provide the results of two assessment cycles for the BS CMPE program (providing the complete line from the 1999 accreditation visit through to the 2006 accreditation), one cycle for the MS CMPE program, and the initial stages of the assessment process for the other two programs.

B.1.1 BS in CMPE

B.1.1.1 Fall 1999 Review

The Fall 1999 accreditation report cited one weakness and made three observations. All were addressed during the due process period, and the Final Statement of August 15, 2000 stated that the one weakness had been “adequately addressed” and acknowledged that the observations had been acted upon.

To recap the points made then:

The weakness:

There was inadequate evidence to demonstrate that the graduates have knowledge of probability and statistics including applications appropriate to the program objectives and that graduates have knowledge of discrete mathematics. Although these topics are introduced in some courses, the depth of coverage and their use needs to be strengthened.

The response:

Changes were made to CMPE 130, Computer File Processing to strengthen the coverage of probability and statistics. Math 42 “Discrete Mathematics” was added as a requirement.

EAC concluded:

The weakness has been adequately addressed.

Three observations were made

Observation 1:

The program is proposing a new required course in Introduction to Discrete Mathematics and Logic, and it is highly recommended that this course be implemented.

All students are required to take Math 042 (Discrete Mathematics) from the Mathematics Department.

Observation 2:

More modern laboratories in the senior technical elective areas would benefit the department.

In the August 15, 2000 Final Statement the EAC was “pleased to acknowledge the improvements of the laboratories” by the end of the due process period.

The laboratories are continually upgraded, and the current set is shown in Table B.8.2.1. The university (and the department) is in the process of deploying a campus-wide wireless network, and requiring all students to acquire a laptop with sufficient capability to allow most of the software development work to be done on the students’ own computers. As a consequence the teaching becomes ever-more interactive and the distinction between lecture and laboratory is diminished in some of the courses.

Observation 3:

Students would like to see the technical electives offered more often. This would be possible if the program had more full-time faculty members.

In the August 15, 2000 Final Statement the EAC was “pleased to acknowledge the ... introduction of proposed new technical electives” by the end of the due process period.

The calendar of technical electives during the period under review is shown in Table B.1.1.1.1.
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<th>Course Code</th>
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<td>CMPE 133</td>
<td>Software Engineering II</td>
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<td>CMPE 135</td>
<td>Object-Oriented Analysis and Design</td>
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<td>CMPE 136</td>
<td>Information Engineering</td>
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<td>Mobile Software Design</td>
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<td>System-on-Chip Design</td>
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<td>Software Patterns</td>
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<td>Software Quality and Test</td>
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<td>Embedded Real-Time Software Systems</td>
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Table B.1.1.1 Technical Electives

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Based on the improvement cycles depicted in Figure B.4.5.1.1 and the university procedures, the Computer Engineering Department has implemented a systematic process for program curricular changes and course content changes. Figure B.1.1.1.1 illustrates the process for curriculum and course changes.

Figure B.1.1.1.1 Curriculum and Course Change Process

1. Access curriculum/course
2. Propose curriculum/course change
3. Reviewed by Department Undergraduate Studies Committee
4. [impacted courses = 1] or [impacted courses > 1]
5. Reviewed by all faculty
6. Generate Curriculum Change Form
7. Reviewed by College Undergraduate Studies Committee
8. Reviewed by University Undergraduate Studies Committee
9. Implement change
Due to the university processes, the delay from the moment a curricular change decision has been made by the department until it takes effect is at least one, but usually two semesters. Thus, the whole feedback loop is of some two year’s duration when changes affect the catalog.

B.1.1.1.1 Curricular Changes
Since Fall 2001, the Computer Engineering program has improved its curriculum through a series of curricular changes. The following highlights the key curricular changes since Fall 2001:

**Fall 2001 Curricular Changes**
- **CMPE 101 (New requirement):** Because CMPE 126 is one of the first courses that transfer students take when matriculating into SJSU, there was a big difference in C++ background, knowledge, and programming skills which are covered in the CMPE 046 prerequisite to CMPE 126. The need therefore arose to ensure that all CMPE 126 students had the requisite C++ background and preparation. The CMPE 101 placement exam was initiated to investigate this need. Market testing was conducted that correlated the performance of student in the CMPE 101 exam and their subsequent performance in CMPE 126. A sufficient correlation to improvement in student performance warranted the initiation of CMPE 101 as a new requirement to the program.
- **CMPE 124 (New prerequisite):** The EE 101 placement exam requirement was initiated in fall 2000 to ensure students had the requisite preparation in introductory knowledge of circuit analysis and design concepts. It was deemed that the content of the CMPE 124 course required this introductory knowledge of circuit analysis and design concepts to improve student performance in this course, thus EE 101 was added as a prerequisite.
- **EE 97 (New requirement):** Students require a lab component to exercise and reinforce concepts in circuit analysis and design.
- **MATH 42 (New requirement):** Based on the recommendation of the previous ABET visit, MATH 42 requirement was added.
- **Technical electives (Unit requirement):** In order to accommodate the new curriculum requirements of CMPE 101, EE 097 & MATH 42 the number of required units for the technical elective requirement change from 12 units to 9 units. (The California State University system does in effect not allow the department to increase the number of units in the program.)

**Fall 2003 Curricular Changes**
- **CMPE 110 (Replacement):** CMPE 110 combined the necessary elements of EE 110 and EE 122 in one course. It retains most of EE 110 content, and emphasizes the digital aspects of EE 122 in greater detail. Therefore the EE 110 and EE 122 required courses were replaced by the new CMPE 110 course requirement. Students are allowed to take EE 110 and EE 122 as technical elective courses to strengthen their analog background.
- **CMPE 102 (New requirement):** The department determined that assembly language programming was a necessary element for the undergraduate curriculum. In conjunction with the replacement of EE 110 and EE 122 with the new CMPE 110 course a sufficient amount of unit hours was freed up to add CMPE 102 as a new required course.

**Spring 2004 Curricular Changes**
- **CMPE 140 (Prerequisite changes):** CMPE 140 students showed a lack of basic logic design skills, thus the CMPE 125 prerequisite was added to compensate. Since CMPE 140 emphasized the micro-architecture design of a RISC CPU scalar, CMPE 127 was removed as prerequisite restriction.

**Fall 2004 Curricular Changes**
- **CMPE 124 (New prerequisite):** The CMPE 124 course required both introductory circuit analysis and design (covered in EE 98 which is a prerequisite to EE 101) as well as the laboratory component (EE 97) to cover materials not included in EE 98. EE 97 therefore was added as a new prerequisite.

**B.1.1.2 Content Changes**
The data gathered in the student surveys, the employer evaluation surveys, and other sources are being used by the faculty to address those areas of the program where there is particular room for improvement.
Most changes within a course are minor, involving didactics rather than changes in course content. However, the capstone project sequence has seen some significant content upgrades. Even though the student surveys and internship supervisor evaluations were generally very positive, there were a few areas that the students and employers indicated needed improvement (see Table B.4.5.1.4.2.1).

The Computer Engineering program has changed the format of its senior capstone sequence (CMPE 195A and B) to place a greater emphasis on communication skills, life-long learning, multi-disciplinary exposure and awareness of the global context in which the graduates will find themselves:

1. CMPE 195A (Sr. Project I) has added a lecture series on topics such as teamwork, research skills (life-long learning), and engineering ethics.
2. CMPE 195B (Sr. Project II) has added a multi-disciplinary lecture series on leading edge technologies and the global nature of the engineering professions (the lecturers are technology and corporate leaders from Silicon Valley).
3. CMPE 195B provides a tutor for written communication to the class, with weekly tutoring sessions for students who need (or want) to improve their skills in written communication.
4. All capstone project reports are reviewed by two faculty members.
5. All presentations are reviewed by at least two faculty members.

B.1.1.1.3 Other Changes

The feedback from students with respect to the quality of advising received by non-academic staff has caused the college to evaluate ways to improve on the process of advising students on the non-academic aspects of their progress towards a degree. Specifically, Spring 2005 the college established an undergraduate students advising center, with the mission of providing exactly such support to the student population. Feedback from students on the Exit Survey has also caused the department to evaluate options for providing improved remote access to the computing infrastructure in the department laboratories. We expect an additional laboratory to be made available for remote access starting fall 2005, and with the addition of the university campus-wide wireless network, we expect that the students’ satisfaction with their access will improve.

B.1.1.1.4 Faculty Assessment

At San Jose State University, faculty members are evaluated at many levels and throughout their careers. The tenure-track probationary faculty member undergoes the typical arduous 6-year RTP (Retention, Tenure, and Promotion) process which evaluates him/her in three areas (teaching, scholarship and professional activity) with primary emphasis on teaching. To obtain tenure, the candidate must be a very good teacher as indicated by peer and student opinion of teaching effectiveness (SOTE). Further, the successful candidate must demonstrate excellence in one of the three areas and satisfactory performance in the other two. The university has recently installed a permanent post-tenure-review requirement. This process is primarily for ensuring ongoing faculty vitality and contributions. It is intended to achieve this by having the faculty members documenting recent achievements and activities, and develop a 5-year plan. The Academic Senate and the university is in the process of reviewing the RTP policies, the objective being to make it a better predictor for future faculty performance and to lighten the administrative burden that the review process places on the candidates.

Over the years, the department has developed a group of part-time lecturers that provide quality instruction and an industry professional perspective. These industry engineers bring a valuable industry perspective and applications to their classes and provide a valuable contribution to the program beyond the service of teaching any particular course. Part-time faculty members routinely participate in faculty meetings and contribute to the curriculum development and other service tasks within the department. Ongoing assessment of tenure-track faculty is provided through the student SOTE evaluations, peer evaluations, and the university-required periodic evaluations. Part-time lecturers are routinely evaluated once per year through a department review of their student evaluations, peer evaluations, and self-written annual summary of achievements. Most of the part-time lecturers in the department have a long-standing relationship with the department and are well-known resources as teachers.
B.1.1.2 Spring 2006 Review

B.1.1.2.1 Spring 2006 ABET Final Report

Introduction

The Computer Engineering Department offers bachelors and masters degrees. Departmental enrollment peaked in 2001-2002 and has since declined by nearly 50 percent to 522 full-time and 138 part-time undergraduate students in the current year. The faculty feels this enrollment is more consistent with the available faculty and facility resources. The program has 16 full-time (including the chair with some administrative time), 2 part-time, and 14 adjunct faculty members. While the program may be completed in four years, many students take longer due to their part-time status. It appears that the vast majority of students have course credits transferred from other California institutions.

Program Strengths

1. A particular strength of the program is the hands-on laboratory experiences gained by students and an unusually rich exposure to the use of modern engineering design and analysis tools due to its proximity to Silicon Valley industries.

2. The faculty members are well qualified. While carrying rather heavy teaching loads, they find time to interact with students, do research, and engage in professional development activities. They show a great deal of interest in the academic success of the undergraduate students.

3. The student body is unusually diverse. They are enthusiastic about their studies and their future as engineering practitioners.

4. The program is commended for its success in obtaining many corporate gifts of equipment and major software packages that enable students to experience a broad spectrum of modern development and analysis tools.

Program Concerns

1. **Criterion 2. Educational Objectives** This criterion requires the program to establish educational objectives that are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve. While one of the chosen objectives is judged to meet this requirement, there is a concern that most of the objectives are statements of post-graduation outcomes assessment of what graduates know and are able to do. Revised objectives will need a revised process to evaluate the extent to which these objectives are met.

   - **Due-process response:** The EAC acknowledges documentation of program educational objectives reworded with input from the department advisory council to more clearly denote their focus on professional career activities and accomplishments and to be more easily measurable. The advisory council suggested assessment methods that would be suitable for use in industry and within professional frameworks.

   - The concern is resolved.

2. **Criterion 3. Program Outcomes and Assessment** It appears there is an assumption that the content of the General Education component, in conjunction with material presented in the first-year ENG 10 course, is sufficient to assure that students have an adequate understanding of their professional and ethical responsibilities as engineering practitioners. There is a concern that this important outcome is not adequately reinforced and assessed during subsequent engineering courses, particularly those that include major design experience projects that simulate engineering practice.
• **Due-process response:** The EAC acknowledges receipt of documentation that the program, in consultation with the department advisory council, has made a particular general education course a degree requirement starting in Fall 2006. The junior-level course, TECH 198 – Technology and Civilization, directly addresses the societal and ethical context of the engineering profession. The program has also added a professional assessment component to the major design experience course to emphasize to the students the importance of the professional component in their project designs.

• The concern remains, pending implementation of the planned actions and demonstration of student understanding of their professional and ethical responsibilities as engineering practitioners.

3. **Criterion 4. Professional Component** While there is evidence that some design projects incorporate the use of engineering standards and some constraints, it is not evident that this is a required element in the selection and approval of design projects. In the absence of a specific strategy for this consideration, there is a concern that this important element in the preparation for engineering practice may not be uniformly accomplished in the future.

• **Due-process response:** The EAC acknowledges receipt of documentation that the major design experience course requirements have been revised to include compliance with at least three industry standards and identification and management of product and process constraints. Student performance evaluation includes these requirements.

• The concern is resolved.

**Program Observations**

1. The faculty is encouraged to identify and implement additional opportunities for students to demonstrate their knowledge of probability and statistics in applications appropriate to the field of computer engineering.

2. External constituencies and faculty have identified the need for computer engineering graduates to have an understanding of computer networks. While the majority of the students gain this knowledge by taking Computer Networks 1 (CMPE 148) as an elective course, the program is urged to incorporate computer networking into the required curriculum.

• **Due-process response:** The EAC acknowledges receipt of information stating that the networking course, CMPE 148, will be required part of the curriculum. This action is directed at both observations. The course includes a substantial amount of probability and statistics, and these topics will be assessed in the course outcomes. The program is also looking at how probability and statistics can be given additional emphasis in courses where it is already incorporated. The EAC acknowledges the efforts made by the computer.

**B.1.1.2.2 Program Change Activities**

• The program reworded program educational objectives with input from the department advisory council to more clearly denote their focus on professional career activities and accomplishments and to be more easily measurable. The advisory council suggested assessment methods that would be suitable for use in industry and within professional frameworks.

• The program, in consultation with the department advisory council, has made a particular general education course a degree requirement starting in Fall 2006. The junior-level course, TECH 198 – Technology and Civilization, directly addresses the societal and ethical context of the engineering profession.
• The program has added a professional assessment component to the major design course sequence (CMPE 195A and 195B) to emphasize to the students the importance of the professional component in their project designs.

• CMPE 130 and CMPE 195A incorporate additional opportunities for students to demonstrate their knowledge of probability and statistics in applications appropriate to the field of computer engineering.

• With the constraint of maximum degree units, the program has engage in restructure the curriculum to make a networking course (CMPE 148) as one of the required degree courses.
B.1.2 MS in CMPE – Spring 2005 Review

B.1.2.1 External Reviewer’s Report

On April 21, 2005, the department received following external reviewer’s report from Dr. Gopal Lakhani.

Introduction
This report is a review of the self-study of the MS in computer engineering program prepared by the Computer Engineering Department, San Jose State University. The study is divided into several sections and prepared as per the format suggested by SJSU and CSU system. This review is divided accordingly.

Section A

The Computer Engineering Department is one of the larger units of the San José State University. It offers a broad range of courses and degree programs in the field of computing to the surrounding communities and state of California. At present, the department offers four degree programs: Undergraduate degrees in Computer Engineering (BS CMPE) and in General Engineering (BSE), and graduate degrees in Computer Engineering (MS CMPE, the subject of this report) and Software Engineering (MS SE). A new BS Software Engineering degree is projected as a joint program with the Computer Science Department in the College of Science. The MS SE degree program has two concentrations – Enterprise Software Technologies and Software Systems. This program attracts the maximum of number of students. Thus, the department covers the whole gamut of computing – hardware design, firmware design, software systems, networking, and large-scale systems for information technology.

Besides offering above degree programs to the general student population on the campus, the department also uses special session modes for delivering graduate courses on the premises of one or more industry partners. The department has recently established a series of certificate programs, which consist of four graduate level courses.

The department draws a large number of part-time students. The department is also trying to cater to the International education market by recruiting graduate students from almost all over the world for on-campus programs and by offering courses through partnership with overseas universities on their campuses.

The department is staffed by two administrative support people, one technical support person, and 16 tenure-track faculty members. In addition, the department hires a good number of temporary part-time instructors who have substantial industry background to meet huge teaching demand. The graduate computer engineering program generates roughly a third of total teaching load of the department.

Vision of the department–
Offer recognized undergraduate and graduate programs, be a leading provider of computer engineers in the Silicon Valley, achieve excellence through faculty participation in local IT industry in basic and applied research as well as scholarship.

Vision of the College of Engineering – SJSU
Be a leading provider of high quality, practice-oriented engineering graduates to the Silicon Valley.

Sections B, C, and D

Section B provides highlights of the MS curriculum and graduate student advising. Sections C and D describes the student demand for MS in computer engineering and admission requirements. It also gives demographic division of students. The following is a gist and some comments from the reviewer.

The department serves 771 undergraduate students, 751 MS SE and 351 MS CMPE students for a total of 1873 students. Majority of students pursue graduate programs on part-time basis. Many take only 1-2 courses per semester. A good number of students are possibly taking beginning courses to begin or advance their career in IT industry. Students come from broad spectrum of academic background and professional experience. A large part of students comes from other regions of United States as well from
overseas. The report does not include any break down of student population. Some data are posted by asee.org.

This reviewer strongly believes that there is a strong demand for admission to all graduate programs of the department. The demand has increased after “.com” crash as more laid off engineers decided to obtain graduate degrees. Despite the recent downturn in hiring in the field of information technology, demand for computer software engineers is expected to increase as computer networking continues to grow. Software engineers will be needed to expand integration of Internet technologies and the explosive growth in electronic commerce. As per U. S. Department of Labor, employment of computer hardware engineers is projected to increase even faster than average for all occupations through 2010, reflecting rapid employment growth in the computer and office equipment industry. Since the Computer Engineering department of SJSU is surrounded by electronics and automation industry, the department should continue to see greater demand for graduate courses.

Section E

This section presents availability of financial resources and viability of programs. It describes faculty resources, supporting personnel, faculty hiring successes and problems, and then it describes in detail the process used by the CSU system for computation of full-time student load and expected teaching load per full-time faculty member. It also presents the budgeting process of the university and the allocation method followed within the Engineering college. The section is very comprehensive. The report indicates that the allocation for 2004-05 is same as that for 2002-03 minus 10 % (it will not help but it may be worth reporting here that the Texas Higher Education Board increased the rate of $5.09 per contract hour of engineering courses for 2002-03 to $8.10 for 2004-05 for Texas universities). The self-study report also presents other methods being used to increase funding source. The report describes the financial difficulties faced by the department due to cuts in statewide and university wide funds. A summary of steps taken by the college and the department to reduce effects of budget cuts are as follows:

1. The department is continuously expanding graduate student hours by offering multiple programs to a wide range of students. It is clear from the fact the department is teaching a whole gamut of computer courses from VHDL to databases to E-commerce.
2. The department offers all graduate courses in evenings to serve part-time students the best. It helps in increasing the enrollment.
3. The department is also offering a variety of programs as part of extended education in different formats such as certificate programs taught at industrial sites, open university distance education, cohort programs for other majors, etc. The report indicates that the funds generated by extended education programs are vital to support faculty activities, which would otherwise not be funded.
4. Large enrollments for each class have been adopted to reduce personnel cost and thus offset continuous budget short falls.
5. The department is also using a large number of part-time instructors to teach a large number of graduate courses. Since part-time instructors can be hired at lower pay, it allows department to serve greater teaching load at a lower cost.

The department currently has 16 tenured/tenure-track and two full-time non-tenure-track faculty members. The department also hires a number of part-time instructors from local industry. Based on the schedule of Spring 2005 semester, it appears that most tenure-track faculty members teach two preparations a semester. Some teach three preparations some time. However, in addition, faculty is expected to supervise various laboratories and help students on their projects during assigned hours. At the undergraduate level, each design course has three hour laboratory. At the graduate level, many courses have two hour lab. A load of two preparations per semester is typical in most engineering colleges. (At Texas Tech University, full-time faculty teaching load is 9 hours per semester, but graduate courses, distance education courses, etc. count 1.5 times of regular courses.) It is not known if teaching assistants are hired to help in laboratories and grade projects and how much help is available. There is no difference between undergraduate and graduate course credit in CSU system, which is quite surprising. (For engineering courses, The Texas Higher Education Board assigns weight of 3.01, 3.46, 8.20, and 21.40 to lower division undergraduate, upper division, master, and doctoral hours, respectively. It means that 8.20 students of liberal arts college generate same
save revenue what a single MS student of engineering generates for the college. For CSU, this ratio is 27/16=1.7). Also, it seems that there is no distinction between student hours of part-time students vs. full-time students on the basis of student count.

There are only five full-time faculty members in the department to support all hardware courses offered to both undergraduate and graduate students. With this small number, the department can offer perhaps only the required courses and hardly any electives in the hardware area. Only a few graduate hardware elective courses are scheduled this semester: CMPE 264, 240, 294L (graduate laboratory) and 297. In this situation, students may have to take electives from System Software and Enterprise Software areas. This appears to be a serious limitation of MS computer engineering program currently and this situation should be corrected soon. It is recommended that department recruit very soon at least two more faculty members in hardware areas.

There is need to understand the problems that arise when a high percentage of students are part-time taking 1-2 courses only. Teaching programming to 4 students, each taking 1 course is lot more time demanding than teaching programming to 1 student who is taking 4 courses. The problem of teaching programming grows if the students transfer from other disciplines to advance their career.

Computer Engineering faculty in Silicon Valley area may be facing another challenge not faced by faculty in regions away from technology centers. Their students are professional engineers, who are working with latest technology at the place of their employment. They expect professors to be very well prepared and informed about new developments in the field. Furthermore, computing and Internet technology grew at phenomenal rate in last 10 years. What it means that the course notes prepared 2 years ago become obsolete and should be updated every year. This is not the case in most other academic fields. (A student remarked on my class evaluation just this past semester that the textbook used in the class was published in 1995. Would a Mathematic professor receive the same comment?) In summary, one needs more preparation time for a graduate course in computer engineering or software enterprise than many other fields at SJSU.

Laboratories – The department has been successful in securing equipment from leading computing industry in the area. It has adequate computing facilities for instruction. However, there is only one technician for the entire department. This is a cause of concern, because laboratory use and maintenance has become faculty member’s responsibility. This should add to work load of already busy faculty members. Technical support is more important to hardware courses.

Section F describes efforts being taken to share resources with other programs. The Computer Engineering and Electrical Engineering departments share laboratories and courses (no list of “crosslisted” courses is given). At present, Computer Engineering department students can take 6 units from other related departments or transfer them. This option is typical and followed by most programs everywhere. This reviewer believes that this number may be increased to nine for MS in Computer Engineering students if they desire to take courses in areas such as communication/signal processing, digital imaging and vision, not offered by the department but offered by Electrical Engineering.

Section G presents productivity of faculty in form of publications and their ability to attract research contracts. The faculty should be commended for their achievements. The quality of their publications is comparable to publications of research-oriented departments at other universities. The list of project titles given in Appendix G also shows that faculty is advising students on research topics of current interests in the field.

By being in Silicon Valley, the department has been able to attract high quality faculty members. Vitae given in Appendix I show that they came with high accomplishments. The same faculty members now think that they do not have necessary free time to pursue research and other scholarly activities. They believe that if they did not remain productive, they would fall behind to their peers at other universities and that it would hurt them eventually.
Section H presents the steps taken by the department to enhance instructional quality. It describes use of Internet for class discussion, distribution and collection of assignments, extended education courses, etc. By being in the hub of technology, the department is expected to make the best use of Internet for instructions.

Section I presents program planning. It gives motivation for offering new programs, BS SE and MS SE. The department argues that courses in software engineering offered by the department will add another alternative to the traditional MS in computer engineering program. A question arises whether the new programs and influx of new trendy courses will shift the focus of hardware engineering teaching to software engineering and development. It is hoped that new programs will have similar breadth and depth.

M.S. Computer Engineering program offers two choices – Thesis or Project. All students take (1) two core courses - CMPE 200 Computer Architecture, and CMPE 220 System Software, (2) three courses from an area of specialization, (3) three or four electives, (4) Thesis or project, and (5) a writing course. (The course description of CMPE 220 seems to suggest that the course is suited for those who join graduate program with non-CS undergraduate.)

The areas of specialization supported by the faculty of the department are:

1. Hardware chip and system design
2. System software engineering
3. Networking and distributed systems
4. Multi-media systems
5. Microcomputers and embedded systems
6. Intelligent systems and robotics
7. Internet technology and applications.

The university catalog or any web page does not give the core courses for different specializations. By identifying such courses and assuring that all such courses are taught more frequently, students will be able to plan their degree plan with greater certainty. Electrical Engineering department provides a clearer description by areas which may be followed. The self-study report states the department has gained strength in embedded systems. Since CMPE 200 and 220 are core courses for all graduate students in the department, should a course on embedded system be required to make it a focal point of computer engineering graduate program at SJSU?

The study plan does not give any outline of different MS programs to suggest how various MS programs are different from each other. Appendix I contains a list of courses in the catalog and responses of faculty members on their preparedness. Based on the areas of specialties and this listing, it seems that faculty concentration can be divided as following – Computer hardware (four), Software engineering (five), Software systems (two), and Networking (two), intelligent system and robotics (two), and enterprise software (two). Are there enough faculty members to teach, advice, assess quality, and participate in operations of all programs? How does the department assure that it would be able to offer enough courses for every MS program for full-time students to graduate in expected time frame?

Even if dual listed courses (possibly offered by other departments) are taken out, the list is unusually big for a non-Ph.D. offering department. An understanding this reviewer received is that a number of courses are offered regularly, a good number of courses are taught once say every 2 years and many have not been offered for long time. There are several courses which have very similar titles and course description. There exists potential for students to take a very similar course as two different electives under two course numbers.

M.S. Computer Engineering program at SJSU is different from traditional MS in computer engineering because the program is offered by the same department, which also offers (just started) an MS in software engineering. In most universities, MS in computer engineering is offered by Electrical Engineering department or Electrical and Computer Engineering department; the MS in software engineering is offered by computer science department, (which may even be outside college of engineering).
Given this distinction, it is hard to compare it with a similar program elsewhere. Search using grad-school.com did not lead to a comparable program with in the state of California. Most universities in CSU system offer MS in Electrical Engineering only. Some UC system universities do offer MS in computer engineering, but their mission is very different. Another difficulty in making a comparison is that no data is given in the self-study such as number of MS graduated with different options, number of students admitted, etc.

This reviewer found some data posted by asee.org, but accuracy of this data can not be assured.

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<table>
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Given above, Santa Clara University’s MS in computer engineering seems to be a good competition.

**Graduate student advising**

It seems that the responsibility of student advising rests mostly with the lone graduate coordinator. There is web page and students should try to find answers there first and then meet the coordinator, if necessary. In order to serve a large number of students, the coordinator can spend only a short time. This reviewer could meet with only a small number of graduate students (three), who expressed their dissatisfaction with this situation.

**Hiring Plan:** The department’s five year plan has clearly identified the number of faculty members and their specializations needed in the next five year. The need for additional faculty in hardware is indeed critical. The department has faced difficulty in hiring new Ph.Ds in computer hardware areas like a lot of other universities have faced. One difficulty in attracting qualified candidates is that SJSU is a non-Ph.D granting university. Another difficulty is definitely the cost of living in San Jose area. To expand pool of applicants and attract qualified candidates, the department has opened up associate and full professor ranks. This approach should attract PhDs, who may want to return to academia after working in industry for some time. Their industrial experience will be an asset.

**Conclusion**

1. The self-study offers a solid plan to meet the mission of the department of Computer Engineering and the Engineering college. The department is aggressively following all options to fund their operations. At the same time, it is continuously upgrading academic programs and adding new courses to incorporate new developments in the field. The faculty members are meeting demands of computer and software engineers in Silicon Valley. They are competing very well.

2. The department has been successfully meeting its goal to be a leading provider of computer engineers. It has been graduating 70-80 Masters every year over last 6 years. To meet current demand of professionals in all aspects of computing, the department plans to offer multiple MS programs and teach wide range of courses ranging from VHDL (circuit design) to E-commerce Enterprise software. The department seems to be also continuously extending its educational services by offering various programs in different formats such as certificate programs taught at industrial sites, open university distance education, and cohort programs for other majors, etc. The report indicates that the funds generated by extended education programs are vital to support faculty activities,
which would otherwise not be funded. Furthermore, large enrollments for each class have been adopted to reduce personnel cost and thus offset budget shortages. The department is also using a large number of part-time temporary instructors to teach a large number of graduate courses. Since part-time instructors can be hired at lower pay, it allows department to generate greater teaching load at a lower cost. It seems that ability of faculty to teach variety of courses to large classes is being badly tested. The assessment of faculty that instruction quality may be in jeopardy is justified.

3. The reviewer could meet with a very small number (3) of graduate students. It is difficult to draw any opinion from this small input. An alternative is to conduct a survey and seek opinion of students who are ready to graduate or have graduated recently. Results of the survey may be appended to this report.

4. The self-study prepared by the department is comprehensive and faculty members who drafted the report should be commended. The study would improve if some statistical data are given to support assessment. For example – (a) Number of different course prepared by faculty members over a period of time. (b) Number contact hours per FTE. (c) Credit hours generated per faculty. This would indicate that the teaching load has been increasing. (d) Ratio of department budget per student hour. This should give tell that budget has been falling and students hours increasing. (e) Number of students graduated. (f) Number of courses and lab hours which should be scheduled every semester.

5. The problem of budget shortage is not going to vanish tomorrow. The state of California (CSU system) may not be able to fund higher education much differently next year. The only solution is that society should pay for higher education directly. For the same reason, the Texas Legislatures allowed last year to each Texas university board to set its tuition rate. Texas Tech University increased tuition by 36% in 2004-05. CSU system should take a similar route.

B.1.2.2 Department Response

On May 11, 2005, Computer Engineering Department adopted following report as department response.

Introduction
The Graduate Studies Committee of the Computer Engineering department at San Jose State University would like to thank Professor Gopal Lakhani at Texas Tech University for reviewing the self-study of the MS in Computer Engineering program, prepared by the department and dated March 15, 2005, for visiting the department Fall 2004 and for his report of his findings with regard to the MS Computer Engineering degree program. The committee voted unanimously to accept the findings of the report. Here we summarize these findings and outline action items that the committee recommends the department to take.

Summary of the Findings of External Reviewer:

- The self-study offers a solid plan to meet the mission of the department of Computer Engineering and the Engineering College.
- The department has been successfully meeting its goal to be a leading provider of computer engineers.
- The reviewer could meet with a very small number (3) of graduate students. It is difficult to draw any opinion from this small input.
- The self-study prepared by the department is comprehensive and faculty members who drafted the report should be commended.
- The problem of budget shortage is not going to vanish tomorrow. The state of California (CSU system) may not be able to fund higher education much differently next year. The only solution is that society should pay for higher education directly.
- There is no difference between undergraduate and graduate course credit in CSU system. This is unlike many other universities, and represents a problem that should be addressed.
• There are only five full-time faculty members in the department to support all hardware courses offered to both undergraduate and graduate students. It is recommended that the department recruit very soon at least two more faculty members in hardware areas.
• A faculty member may need more preparation time for a graduate course in computer engineering or software engineering than other fields at SJSU where the knowledge domain changes less rapidly.
• There is only one technician for the entire department. This is a cause of concern, because laboratory use and maintenance has become faculty member’s responsibility. This should add to work load of already busy faculty members.
• The university catalog or any web page does not give the core courses for different specializations within the program. By identifying such courses and assuring that all such courses are taught more frequently, students will be able to plan their degree plan with greater certainty.
• The study plan does not give any outline of different MS specializations to suggest how they differ.
• The self-study report lists 52 graduate level courses. There are several courses which have very similar titles and course description. There exists potential for students to take a very similar course as two different electives under two course numbers.
• It seems that the responsibility for student advising rests to a large extent with the lone graduate coordinator. In order to serve a large number of students, the coordinator can spend only a short time.

**Action Items**
The committee recommends that
• The department should proceed aggressively to recruit at least one faculty member in the embedded systems hardware area.
• The department should be provided with the resources to expand the technical support for the department laboratories.
• The department’s SFR should be decreased to a level more closely in line with that of other engineering departments.
• The department should clearly identify curricula for specific specializations within the MS CMPE degree program.
• The department should endeavor to articulate more clearly the distinction between the two MS degree programs.
• The department should review and streamline its graduate level course inventory.

**B.1.2.3 College of Engineering Assessment**
The College of Engineering Computer Engineering Department has completed a self-study of the MS Computer Engineering Degree program. This process consisted of preparing a self-study report, having a review by an external reviewer, Dr. Lakhani from Texas Tech, and then developing a set of activities to implement program improvement. Documents produced for this self-study were provided to the GS&R Committee for review and comment prior to submission to the Dean of the College of Engineering.

The objective of the COE GS&R committee review was to confirm the self-study was objective and comprehensive and that the department was acting on implementing the identified opportunities for improvement. The opinion of the committee is that the self-study had met these criteria. The report prepared by the external reviewer indicated the department self-study report had adequately addressed each of the program components to allow his objective evaluation. The department response to Dr. Lakhani’s external reviewer report acknowledged the items emphasized in his assessment and resulted in a list of seven (7) action items. The department has added an additional item in the course of implementing that action plan. A summary of the current status of these improvement activities is attached below.

It is the opinion of the GS&R committee that the Computer Engineering Department has conducted a successful self-study that has been used to produce and implement a development plan. We recommend that this self-study be sent forward to the University GS&R Office as a record of a successfully completed activity.
Status of the improvement activities for the MS CMPE program

The list of activities has been categorized into two groups; those that are dependent upon the availability of additional resources and those that can be addressed with current resources. The notation refers to the listing provided in the original department response letter.

Activities that can be addressed with Current Resources

• The department should clearly identify curricula for specific specializations within the MS CMPE degree programs.

  Status: The CMPE field is continuing to evolve and this will require constant effort to maintain a contemporary curriculum. Activities to address this item include numbers of discussions: within the CMPE Graduate Studies Committee; at the department meetings; and a meeting with the Industry Advisory Board members. The following new concentration areas have currently been identified: Computer and Digital Hardware; Networking; Embedded Systems; and Secure Computing. Changes implemented include developing new courses and revising old course descriptions to reflect the current content; but this will be an ongoing activity.

• The department should endeavor to articulate more clearly the distinction between the two MS degree programs.

  Status: The department has developed distinct background and course requirements (e.g., prerequisites, required courses, and electives) for the two MS degree programs (computer engineering, software engineering) offered by the Computer Engineering Department. This activity has been completely implemented.

• The department should review and streamline its graduate level course inventory.

  Status: The department has taken the following actions: 1) regrouped the CMPE program graduate courses based on areas, indicated their status (active/non-active, and offering schedule for the active ones), and posted the course list online; 2) carefully evaluate newly proposed courses to prevent duplication; and 3) in the process of revamping/updating courses that have not been offered for years. As mentioned in item 3.4 above, this will be a continuing activity to maintain an accurate and contemporary group of MS courses.

• The department should establish a more systematic program assessment procedure.

  Status: The department has identified its CMPE program outcomes, and developed an assessment plan with a variety of assessment tools and a timetable for implementation. The assessment planning process has been successfully implemented as an integral component in the program. Program assessment using the revised process is in initial implementation phases during the Fall 2005 Semester.

Activities that can be addressed with Additional Resources

• The department should proceed aggressively to recruit at least one faculty member in the embedded systems hardware area.

  Status: The department advertised, interviewed, and identified a candidate to hire, but the hiring was cancelled due to the lack of budget. This recruitment can be reactivated with an improved budget.

• The department should be provided with the resource to expand the technical support for the department laboratories.

  Status: This item requires additional economic resources to implement. This recruitment can be activated with an improved budget.
• The department’s SFR should be decreased to a level more closely in line with that of other engineering departments.

Status: The solution to this item is to bring in new faculty member(s), as per item 3.1. The number of graduate students varies year-to-year and the department has been attempting to meet the demand with available full and part-time faculty resources.

• The department should make an effort to provide adequate student advising to the large number (410) of graduate students.

Status: The department has implemented a systematic and organized procedure for graduate advising, and the graduate coordinator spends at least 3.5 hours per week (on average) on face-to-face graduate advising. The additional advising activities for this individual included the offline document reviewing/processing and phone/email interactions with students. Additional secretarial support is definitely required for the number of students advised in this program and staffing that position would require additional economic resources.

B.1.2.4 Program Change Activities

• The department is recruiting a faculty member in the embedded systems hardware area.

• The program identified 4 specific specializations - system design, network systems, embedded systems, secured systems. From fall 2007, each student is required to declare a specialization and take a minimum of 3 specialization courses. This change will articulate more clearly the distinction between the two MS degree programs.

• The department should review and streamline its graduate level course inventory by renaming the titles and enhancing the contents of following courses:
  o CMPE 241 – Embedded System Development Tools
  o CMPE 242 – Embedded Hardware Design
  o CMPE 243 – Embedded System Applications
  o CMPE 244 – Embedded Software Design

• The program has identified 6 program outcomes, and developed an assessment plan with a variety of assessment tools and a timetable for implementation. The assessment planning process has been enhanced as an integral component in the program. Degree core (CMPE 200 and 220), master project (CMPE 295A and 295B) and technical communication (CMPE 294) are included in the program assessment process. The process also include student, alumni and employer surveys as well as inputs from members of Department Advisory Council.
B.2 Program Planning Overview
B.2.1 Assessment Life-Cycle Processes
B.2.1.1 BS in CMPE and BS in SE

Figure B.2.1.1.1 The Program Enhancement Processes
B.2.1.2 MS in CMPE and MS in SE

**Figure B.2.1.2.1 The Program Enhancement Processes**

- Institutional mission and goals
- Establish and enhance Program Outcomes
- Assess the Program Outcome Achievements
- Program Report
- Course Journal
- Enhance course
- Enhance curriculum
- Student course performance
- Student course feedback
- Senior/Junior feedback
- Student exit focus groups and survey
- Alumni feedback
- Employer feedback
- Advisory Council feedback

Program delivery
B.2.2 Assessment Life-Cycle Matrix

B.2.2.1 BS in CMPE

Table B.4.5.1.1 Schedule of Assessment Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Fall 2005</th>
<th>Spring 2006</th>
<th>Fall 2006</th>
<th>Spring 2007</th>
<th>Fall 2007</th>
<th>Spring 2008</th>
</tr>
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<tbody>
<tr>
<td>Assess program educational objectives</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Assess program outcomes w.r.t. PEOs</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Assess curriculum w.r.t. POs</td>
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<td>✓</td>
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<tr>
<td>Assess courses</td>
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</table>

Assessment mechanisms

Feedback mechanisms

<table>
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<tr>
<th>Method</th>
<th>Fall 2005</th>
<th>Spring 2006</th>
<th>Fall 2006</th>
<th>Spring 2007</th>
<th>Fall 2007</th>
<th>Spring 2008</th>
</tr>
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<tr>
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<td>✓</td>
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<td>Curriculum evaluation</td>
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<td>✓</td>
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<td>✓</td>
</tr>
</tbody>
</table>

1 Not all retreats are focused on the BS Computer Engineering program
2 Not all meetings of the Department Advisory Council are focused on the BS Computer Engineering program
B.2.2.3 BS in SE

<table>
<thead>
<tr>
<th>Activity</th>
<th>Fall 2005</th>
<th>Spring 2006</th>
<th>Fall 2006</th>
<th>Spring 2007</th>
<th>Fall 2007</th>
<th>Spring 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess program educational objectives</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Assess program outcomes w.r.t. PEOs</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Assess curriculum w.r.t. POs</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Assess courses</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Feedback mechanisms

<table>
<thead>
<tr>
<th>Method</th>
<th>Fall 2005</th>
<th>Spring 2006</th>
<th>Fall 2006</th>
<th>Spring 2007</th>
<th>Fall 2007</th>
<th>Spring 2008</th>
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<tr>
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<td>Communication course assessment – CMPE 294</td>
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<td>Student surveys</td>
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<td>Advisory council evaluation</td>
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</table>

B.2.2.4 MS in SE

B.3 Students
B.3.1 Student Enrollment for the Last Five Years and Projection

Student enrollment in the department programs over the last five years is shown in Table B.3.1.1.
Table B.3.1.1 Enrollment Statistics for the Computer Engineering Department
(in calendar year FTES)$^3$

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
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<tbody>
<tr>
<td>BS CmpE</td>
<td>256</td>
<td>207</td>
<td>170</td>
<td>155</td>
<td>117</td>
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<tr>
<td>BS SE</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>MS CmpE</td>
<td>103</td>
<td>99</td>
<td>114</td>
<td>121</td>
<td>129</td>
</tr>
<tr>
<td>MS SE</td>
<td>0</td>
<td>0</td>
<td>173</td>
<td>203</td>
<td>279</td>
</tr>
<tr>
<td>Off-campus</td>
<td>12</td>
<td>49</td>
<td>33</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total FTES</strong></td>
<td>371</td>
<td>355</td>
<td>490</td>
<td>496</td>
<td>544</td>
</tr>
</tbody>
</table>

The overall enrollment numbers have been growing, however, there has been a radical shift from undergraduate to graduate enrollment, and projecting forward we expect to stabilize the undergraduate enrollment numbers (and we’ve seen a small up-tick in the BS SE program), and possibly grow the graduate programs further.

The decline in enrollments is a national challenge for IT-related departments and programs – and compared to the other departments at SJSU in this area (Electrical Engineering and Computer Science) the Computer Engineering Department has been fortunate in its student recruiting (cfr. the graph below).

![Enrollment in IT related departments](image)

B.3.2 Student Sources
B.3.2.1 BS in CMPE and BS in SE

There are three ways that students enter the programs:
- Direct entry from high school or after less than 2 years of college work (lower division entry)
- External transfer after at least 2 years of college work elsewhere (upper division transfer)
- Internal transfer from other programs

$^3$ Prior to 2004 there was a Software Engineering option within the General Engineering degree, not included here.
B.3.2.1.1 Lower Division Entry
Students with fewer than 60 transferable semester units (90 quarter units) who wish to transfer to San José State University must:

• Submit a high school transcript.
• Submit SAT I or ACT scores, unless the high school GPA was above 3.00 (3.60 for non-residents).
• Meet high school course requirements and make up any deficiencies on a course-by-course basis, usually by completing general education courses with grades of "C" or better.
• Meet the GPA/test score eligibility index required of freshmen.
• Earn at least a 2.00 grade point average in all transferable courses completed.
• Be in good standing at the last college attended.

If the student completed college units before graduating from high school or during the summer between high school and CSU enrollment, the student is still considered a first-time freshman and must meet freshman requirements.

B.3.2.1.2 Upper Division Entry
Students with 60 or more transferable semester units (90 quarter units) who wish to transfer to San José State University must:

• Submit all college transcripts to date at the time of application.
• Be in good standing at the last college or university attended.
• Earn a college grade point average of 2.00 (2.40 for non-residents) or better in all transferable courses.
• Earn a "C" or better grade in each general education course.
• Complete 30 semester units (45 quarter units) of general education, including four basic skills courses:
  - One speech course,
  - One course in English composition,
  - One critical thinking course,
  - A math course with intermediate algebra as a prerequisite.

The basic skills courses must be completed by the spring semester prior to fall admission. For spring admission, they must be completed by the summer prior to admission. This transfer plan clears all course deficiencies that might have occurred in high school.

The requirements for the university to accept transfer students are published in the university catalog and on the SJSU web site at: http://soar.sjsu.edu.

B.3.2.1.3 Evaluation of Transfer Credit
In addition to the admission requirements spelled out above, a student may be able to transfer credits for courses taken at accredited institutions, if the SJSU faculty coordinator evaluates them and determines that they are equivalent to courses required in the SJSU curriculum.

Most lower-division requirements have been certified through articulation agreements with California community colleges (see http://www.assist.org) which expedite the transfer course evaluations.

Students wishing to transfer credits for work done in a class that has not been articulated may petition for an equivalency finding by submitting a course equivalence request form and supporting material from the institution offering the course. The appropriate course coordinator evaluates the request, possibly in conversation with the student, and determines whether the course is considered equivalent in content, and whether unit credit should be awarded.

In cases where transfer credit is not granted (e.g. due to insufficient documentation), students may take special examinations to receive credit for courses they have taken that are similar to those in the program at SJSU.

The transfer credit is re-checked at the time the student submits the major form, and again when the student is graduating.

In addition to communications via memoranda and electronic notifications to provide information about any modifications to programs and courses, an annual meeting between SJSU College of Engi-
neering department chairs and representatives of the main feeder community colleges is conducted to ensure that issues related to transfer credit are addressed adequately. When students transfer to SJSU they are provided with a broad orientation regarding the university and the College of Engineering. Further each student is advised by a faculty advisor about the program requirements, various department program policies and in general the expectations of a student in the program.

B.3.2.1.4 Internal Transfers

Students may transfer to the program from other programs in the university. Typically, these requests are made by students who are currently enrolled in other engineering disciplines, although occasionally a request for transfer is received from a student in another college (such as Computer Science in the College of Science).

In order to transfer the student must be in good standing (i.e., have a GPA $\geq 2.0$), and the department chair must approve and sign off on the request.

B.3.2.2 MS in CMPE and MS in SE

There are two ways that students enter the programs:

- Direct entry from universities
- Internal transfer from other programs

B.3.2.2.1 Process for Acceptance of New Students

Applications for the MS CMPE and MSSE programs are accepted and evaluated for the Fall and Spring semesters. Applications for the MS CMPE and MSSE programs are evaluated first by SJSU graduate admissions then referred to the department for departmental evaluation by the program coordinator/advisor. The graduate admissions office verifies that an applicant has an acceptable undergraduate degree and verifies that the student is proficient in English. An applicant demonstrates proficiency in English by showing that the medium of instruction in his/her undergraduate degree was English or by presenting a passing TOEFL score.

The department evaluation of an application examines several indicators that the applicant will successfully complete a graduate program. Indicators include GPA, standardized test result (such as GRE), academic background, reference letters, and professional background and achievements. The following table lists the indicators that the MS CMPE and MSSE programs use to evaluate an applicant.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>MS CMPE</th>
<th>MSSE</th>
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</thead>
<tbody>
<tr>
<td>GPA</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>GRE (when provided by applicant)</td>
<td></td>
<td>✓</td>
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<tr>
<td>Academic background</td>
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<td>✓</td>
</tr>
<tr>
<td>Reference letters (when provided by applicant)</td>
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<td>✓</td>
</tr>
<tr>
<td>Professional background</td>
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</tbody>
</table>

Applicants for the MS CMPE and MSSE programs typically have undergraduate degrees in computer related fields such as Computer Engineering, Computer Science, or Software Engineering. Occasionally applicants possess degrees in other engineering and science disciplines, and rarely an applicant will have a MIS business degree.

Typically four outcomes result from the application evaluation (see the following table).

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Result</th>
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</thead>
<tbody>
<tr>
<td>Applicant meets all criteria</td>
<td>Admitted fully classified</td>
</tr>
<tr>
<td>Applicant is an excellent student but does not have necessary background</td>
<td>Admitted conditionally classified with assigned undergraduate prerequisite courses to improve background</td>
</tr>
<tr>
<td>Applicant has sufficient background but academic background is lacking</td>
<td>Admitted conditionally classified with minimum</td>
</tr>
</tbody>
</table>
B.3.2.2.2 Internal Transfer Students

Students can transfer between degree programs within SJSU. Typical transfers are between MS CMPE, MSSE, and MSCS. A transfer is initiated by the student by completing a Change of Major form. Once a student submits a change of major, the entire application package plus the transcripts of any completed courses at SJSU are forwarded to the graduate advisor for evaluation. The evaluation is substantially the same as the evaluation of a new application.

B.3.3 Program Orientation for New Students

B.3.3.1 BS in CMPE and BS in SE
Orientation for incoming BS in CMPE and BS in SE students are held at the beginning of each Fall and Spring semester. The orientation is conducted by the university, college, and department representatives. The orientation provides a brief introduction to the following:
- SJSU and Silicon Valley
- The College of Engineering
- The Computer Engineering Department
- The BS in CMPE and BS in SE program requirements
- Common administrative procedures
- General Education requirements and evaluation process
- Transfer credit evaluation process
- The CSU Graduation Writing Assessment Requirement (GWAR)
- Advising

B.3.3.2 MS in CMPE and MS in SE
Orientation for incoming MS in CMPE and MS in SE students are held at the beginning of each Fall and Spring semester. The orientation is conducted by the department chair and the graduate program coordinators. The orientation provides a brief introduction to the following:
- SJSU and Silicon Valley
- The Computer Engineering Department
- The MS CMPE and MSSE program requirements
- Common administrative procedures
- The CSU Graduation Writing Assessment Requirement (GWAR)
- Advising

B.3.4 Advising
B.3.4.1 BS in CMPE and BS in SE
The requirements that a student must satisfy in order to graduate with a BS Computer Engineering degree are defined by the student’s catalog. The catalog is the complete set of university requirements published (in print or on the web) for a particular semester. Each student has the choice of one from among at most four alternative catalogs:
- The catalog in effect when the student last entered the university
- The catalog in effect when the student last entered a California community college
- The catalog in effect when the student transferred into the Computer Engineering program from another program in the university
- The catalog in effect the semester the student graduates.

“Last entered” refers to the first date after which the student has enrolled in at least one course per year until the current date, or has been granted a leave of absence for any semesters that broke such an enrollment sequence.
The objective of advising is to ensure that the student appropriately progresses towards the degree defined by the student’s catalog, and in broader terms to provide a contact point for nurturing the learning environment.

Each student is assigned a major advisor, who is the primary contact for that student. Before a matriculated student commences the program, he/she is given an orientation about the curriculum by the department chair or a major advisor. The student is also directed to the department student guide, available on the web (www.cmpe.sjsu.edu).

During the course of the student’s progress through the program the major advisor is responsible for:

- Evaluating any student request for unit transfers to the major
- Assisting the student with the advising form
- Monitoring the student’s academic progress and maintaining a record of the advising sessions (“Advising Binder”)
- Ensuring that the student complies with the published curriculum for the selected student’s catalog
- Initiating the major form evaluation process
- Verifying the accuracy and the compliance of the major form before it is submitted to the department with an application for graduation

Students must meet with their major advisors at least once every semester. This is enforced by a “hold” placed on the students’ records, preventing them from signing up for the next semester’s courses. The hold is removed to allow the student to register only after the student has been seen by his/her major advisor.

Moreover, a student is required to work with his/her major advisor to develop an acceptable program of study and document it on a major form, which must be on file before the student may register for senior-level courses. This ensures that the student receives early advice on the selection of electives and a review of his/her progress toward the degree.

The major advisor and the department chair must approve and sign off on the major form before forwarding it along with the student’s application for graduation to the Office of Admissions and Records. The Office of Admissions and Records checks the major form to ensure that the student has met all requirements for graduation before inviting the student to participate in the graduation ceremony.

Information material and forms used to assist students in developing their plans are available on the Computer Engineering website and are found in the student guide.

The California State University and the SJSU campus have established a detailed general education curriculum that all undergraduate students must complete. In addition to the student’s major advisor, a student may consult general education advisors at the Assessment Center in the Office of Admissions and Records for assistance in ensuring their compliance with the general education requirements of the curriculum. The general education criteria are found on the SJSU web site (http://www2.sjsu.edu/ugs/ge/ge-main.html). In the student guide, the College of Engineering General Education Checklist is used by students and advisors to monitor and plan their general education progress.

B.3.4.2 MS in CMPE and MS in SE

Information about MS CMPE and MSSE program requirements is available to graduate applicants and students in the SJSU catalog and on the Computer Engineering web site. Program course requirements are structured into several categories:
• Prerequisite undergraduate courses assigned at the time of admissions
• Degree core courses
• Specialization core courses
• Project or Thesis courses
• Graduation Writing Assessment Requirement (GWAR) courses

The department web site specifically enumerates the courses required for each category with the exception of the admission prerequisite courses, which are specified in the admission letter. Exceptions can be made to the standard program plan by establishing a program of studies.

Advising for admission, course plan, and administrative tasks is provided to students and applicants in one of four forms:
• Walk-in group advising sessions, typically held 2-4 times a month.
• Individual advising held by appointment.
• Simple advising via email.
• Process request via the Computer Engineering office.

B.3.5 Monitoring Student Performance

B.3.5.1 BS in CMPE and BS in SE

Student performance is monitored at both the university and department levels. Individual student performance in a course is directly indicated by the grades received, in terms of both summative performance (course grade) and formative assessment (exam grades, etc).

A student is placed on probation by the Office of Admissions and Records when his/her cumulative grade point average (GPA) falls below 2.0 (“C”). The university informs students being placed on probation by letter, notifying them of the problem and requesting that they see their major advisors to develop a plan to improve their performance. Students on probation are disqualified from the major if their SJSU GPA falls below a certain threshold level (determined by their class level).

To ensure that students have a good grasp of fundamental concepts that serve as the basis for more advanced design and analysis courses, students are required to earn a C or better in key mathematics and communication courses (ENGL 1A, ENGL 1B, ENGR 100W, Oral Communication, MATH 30) and a C or better in key computer engineering courses (EE98, CMPE 46, 124, 125, 126, 127, 195A). Students who do not earn the required minimum grade have to repeat the course until they achieve the level of accomplishment required to move on to more advanced material.

B.3.5.2 MS in CMPE and MS in SE

Student performance is monitored at both the university and department levels. Students must maintain a cumulative GPA of 3.0 or higher. When a student’s GPA falls below 3.0, a student is placed on probation by the university. The student must then achieve a semester GPA of greater than 3.0 for each subsequent semester until the student’s cumulative GPA rises to 3.0 or greater. If a student fails to achieve a GPA greater than 3.0, the student is disqualified. Graduate students must achieve a grade of C or greater to pass a graduate class.

B.3.6 Process to Ensure All Students Meet All Program Requirements

B.3.6.1 BS in CMPE and BS in SE

All students are required to work with his/her academic advisor to develop an acceptable program of study and to document it on a major form. There is a separate major form for each catalog, for quality control purposes, to ensure students follow the appropriate catalog.

The major form must be on file before the student may register for senior level courses. This ensures that the student receives early advice on the selection of electives and a review of his/her progress towards the degree. The major advisor and the department chair must approve and sign off on the major form before forwarding it along with the student’s application for graduation to the Office of Admissions and Records. The Office of Admissions and Records checks the major form to ensure that the
student has met all requirements for graduation. When accepted by the Office of Admissions and Records, the major form serves as a contract between the student and the university, clearly specifying the curriculum the student has to complete in order to graduate. Students may choose to change their program of study after their major form has been accepted by the Office of Admissions and Records. Such changes are effected (and monitored) through the filing of a course substitution form. Such course substitution forms must be signed by the student’s major advisor and by the department chair before they are forwarded to the Office of Admissions and Records.

B.3.6.2 MS in CMPE and MS in SE

Graduate students describe how they will complete all program requirements by filing a candidacy form in the semester prior to their graduation. The candidacy form enumerates how a student will meet the requirements for his/her degree program and how he/she has completed any admission prerequisite courses that may have been assigned. The candidacy form also lists how the student has met the Graduation Writing Assessment Requirement (GWAR) requirement and the grades the student received for each completed class. The candidacy form is reviewed and signed by the graduate program coordinator and forwarded to SJSU graduate studies for additional review.

The candidacy form predicts the courses that will be taken in the subsequent semesters. These courses can be modified on the candidacy form by submitting a course substitution form to graduate studies signed by the student’s graduate advisor. The candidacy form is typically submitted at the beginning of his/her masters project or thesis.

B.4 Program Educational Objectives

B.4.1 Constituencies
The computer and software engineering programs serve following constituencies:
• Computer and software engineering students
• Computer and software engineering employers
• College of Engineering programs for which the computer and software engineering program provides service courses
• Computer and software engineering alumni

By extension of the above, the program also serves the State of California as such, and the legislature of the state does take an interest in the running of the California State University system in ways that influence the curricular and operational decisions of each university program.

B.4.2 Program Mission
The Computer Engineering Department has developed and refined its mission through a series of faculty retreats. The current mission statement was established at the Fall 2002 retreat. The department mission is To provide a diverse student population with a high-quality, practice-oriented engineering education, which includes the background knowledge necessary for the design, analysis, and testing of computer and computer-related hardware and software, and the integration of hardware and software into a computer system according to the specifications of the end user and to contribute to the development and codification of this knowledge through faculty scholarship.

B.4.2.1 BS in CMPE
The mission of the program is to provide students with a broad understanding of computer engineering concepts and, through technical electives, the application of these fundamentals to cutting edge computer engineering problems. This provides them with the knowledge required to focus on a particular specialty upon graduation either in the work environment or through attending graduate school. The coursework includes extensive laboratory experience and many opportunities for students to complete applied projects and designs. Four program educational objectives guide the ongoing assessment, evaluation, and evolution of the curriculum.
B.4.2.2 MS in CMPE

The mission of the program is to be the leading provider of highly qualified computer engineers in analysis, design, verification and implementation of computer hardware and software, and their integration into computer systems, and to nurture its students to develop problem-solving, life-long learning and leadership capabilities through excellence in education, research and scholarship.

B.4.2.3 BS in SE

The goal of the BS program in Software Engineering is the preparation of software engineers: professionals who develop software products on time, within budget and that meet customer requirements. The coursework builds on computer science fundamentals and mathematical principles to cover the design, analysis, verification, validation, implementation, deployment, and maintenance of software systems. The program focuses on practical aspects of building and deploying real software systems in a socially.

B.4.2.4 MS in SE

The mission of the program is to be the leading provider of highly qualified computer engineers in analysis, design, verification and implementation of software systems and to nurture its students to develop problem-solving, life-long learning and leadership capabilities through excellence in education, research and scholarship.
B.4.3 Program Educational Objectives for Undergraduate Programs

B.4.3.1 BS in CMPE
The program educational objectives (PEOs) of the BS in CMPE program are to ensure that the graduates are fundamentally sound, practical, participatory, and professional. Specifically, the program prepares the students so that two to three years after completion of the program the successful graduate will have

I. Demonstrated an understanding of the fundamental knowledge that is a prerequisite for the practice of computer engineering, including its scientific principles and the importance of rigorous analysis and creative design.

II. Demonstrated a practice-oriented, hands-on understanding of how to apply theoretical concepts to real world problems.

III. Demonstrated clear communication skills, responsible teamwork, leadership, and professional attitude and ethics.

IV. Successfully entered the engineering profession, and embarked on the process of life-long learning in engineering or other professional areas.

B.4.3.2 BS in SE
The program educational objectives (PEOs) of the BS in SE program are to ensure that the graduates are fundamentally sound, practical, participatory, and professional. Specifically, the program prepares the students so that two to three years after completion of the program the successful graduate will have

I. Demonstrated an understanding of the fundamental knowledge that is a prerequisite for the practice of software engineering, including its scientific principles and the importance of rigorous analysis and creative design.

II. Demonstrated a practice-oriented, hands-on understanding of how to apply theoretical concepts to real world problems.

III. Demonstrated clear communication skills, responsible teamwork, leadership, and professional attitude and ethics.

IV. Successfully entered the engineering profession, and embarked on the process of life-long learning in engineering or other professional areas.

B.4.4 Program Outcomes for Graduate Programs

B.4.4.1 MS in CMPE
The program outcomes of the MS in CMPE program are:

I. Be able to demonstrate an understanding of advanced knowledge of the practice of computer or software engineering, from vision to analysis, design, validation and deployment.

II. Be able to tackle complex engineering problems and tasks, using contemporary engineering principles, methodologies and tools.

III. Be able to demonstrate leadership and the ability to participate in teamwork in an environment with different disciplines of engineering, science and business.

IV. Be aware of ethical, economic and environmental implications of their work, as appropriate.

V. Be able to advance successfully in the engineering profession, and sustain a process of life-long learning in engineer or other professional areas.

VI. Be able to communicate effectively, in both oral and written forms.
B.4.4.2 MS in SE

The program outcomes of the MS in SE program are:

I. Be able to demonstrate an understanding of advanced knowledge of the practice of computer or software engineering, from vision to analysis, design, validation and deployment.

II. Be able to tackle complex engineering problems and tasks, using contemporary engineering principles, methodologies and tools.

III. Be able to demonstrate leadership and the ability to participate in teamwork in an environment with different disciplines of engineering, science and business.

IV. Be aware of ethical, economic and environmental implications of their work, as appropriate.

V. Be able to advance successfully in the engineering profession, and sustain a process of life-long learning in engineer or other professional areas.

VI. Be able to communicate effectively, in both oral and written forms.
B.4.5 Assessment of Program Objectives

B.4.5.1 BS in CMPE and BS in SE

B.4.5.1.1 The process of formulating and Reviewing the Program Educational objectives

The program follows a cyclical improvement process for program educational objectives (as well as for program outcomes and course learning objectives) (see Figure B.4.5.1.1.1). For the program educational objectives the cycle is approximately three years long (the latest cycle being delayed to the middle of the accreditation cycle due to department organization changes and the wish to be synchronized with the ABET evaluation cycle).

At the end of the previous ABET accreditation cycle the College of Engineering Curriculum Task Force established PEOs with input from industry, alumni, students and faculty members in the College of Engineering, taking into account student preparation and performance, industry needs, student perceptions, student retention, professional licensing, general education and engineering accreditation criteria.

The current PEOs are the result of the subsequent assessment/improvement cycle that culminated in 2004. The cycle was initiated with a series of focus groups inviting alumni and employers of our graduates to evaluate the importance of the then-current PEOs, and to suggest improvements (see Figure B.4.5.1.1.2). On the basis of these the PEOs were the main focus of the January 2004 department retreat, where a new set of PEOs were drafted, discussed and refined. These were submitted to the department’s undergraduate studies committee, with the final version being discussed by the Department Advisory Council in September 2004, and then adopted by the department with the approval of the college Dean.

The resulting PEOs are the basis for the current cycle of program evaluation and improvements, and have been posted in the university catalog and on the program website (http://bs.cmpe.sjsu.edu).

Based on these PEOs the department refined the assessment plan which continues to include periodic evaluation and revision of the program educational objectives according to the feedback from employer, alumni, faculty, and students. Figure B.4.5.1.1.3 depicts the complete set of assessment cycles, and how they work together.

The schedule for various assessment activities is shown in Table B.4.5.1.1.
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<th>Activity</th>
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</tbody>
</table>

<sup>4</sup> Not all retreats are focused on the BS Computer Engineering program

<sup>5</sup> Not all meetings of the Department Advisory Council are focused on the BS Computer Engineering program
Figure B.4.5.1.1.3 The Program Enhancement Processes

1. Institutional mission and goals
2. Establish and enhance Program Educational Objectives
3. ABET criteria
4. Assess the PEO Achievements
5. Program Report
6. Establish and enhance Program Outcomes
7. Assess the Program Outcomes Achievements
8. Outcome Report
9. Establish and enhance Program Learning Objectives
10. Assess the Course Learning Objectives Achievements
11. Course Journal
12. Enhance course
13. Enhance curriculum
14. Program delivery
15. Student course performance
16. Student course feedback
17. Senior/Junior feedback
18. Student exit focus groups and survey
19. Alumni feedback
20. Employer feedback
21. Advisory Council feedback
B.4.5.1.2 Achieving the Program Educational Objectives

The program educational objectives are achieved primarily through the program curriculum, which is designed to stress problem solving and design skills, and experiential learning. Building on a foundation of mathematics, science, and basic engineering skills, students complete a sequence of core courses in both computer software ("computer science") and computer hardware ("electrical engineering"). In each one of these courses, the students acquire fundamental concepts and apply these to short design exercises. The students are frequently required to work in teams to complete projects and laboratory exercises. Students also complete three technical electives that allow them to explore one or two computer engineering areas in further depth.

Finally, students integrate all their skills in a year-long senior computer system design course (CMPE 195A and B) as they undertake a team-based design project. This course exposes students to system-level engineering and real-world issues including the global and societal context of engineering, leadership, economics and professional ethics.

While many of the engineering courses require oral presentations or written reports, four upper division courses have been identified as having extensive communication components to ensure that students are given opportunities to perfect their skills (ENGR 100W, Engineering Reports; CMPE 130, File Processing; CMPE 131, Software Engineering I; CMPE 195A&B, Senior Project). Professional and ethical issues are discussed in several courses, but specific curricular units on these topics are provided in ENGR 10 and CMPE 195B.

The department actively provides students with leadership opportunities through its support of the Society for Computer Engineers (which is also the local student chapter of the IEEE/Computer Society). This local student group has over 200 members, and sponsors invited speakers from the Silicon Valley. In addition, the College of Engineering supports the Society of Women Engineers, Black Alliance of Scientists and Engineers, Society of Latino Engineers and Scientists, and Tau Beta Pi, and students are encouraged to join these societies.

B.4.5.1.3 The Relationship between Program Outcomes and Program Educational Objectives

The program outcomes support the program educational objectives, and the main linkages are depicted in Table B.4.5.1.3.1

The assessment of the PEOs is performed bottom-up (through the program outcomes assessment) as well as top-down (through constituency feedback).
Table B.4.5.1.3.1 The support of the PEOs through the Program Outcomes

<table>
<thead>
<tr>
<th>Program Educational Objectives</th>
<th>Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Demonstrated an understanding of the fundamental knowledge that is a prerequisite for the practice of computer engineering, including its scientific principles and the importance of rigorous analysis and creative design.</td>
<td>x</td>
</tr>
<tr>
<td>II. Demonstrated a practice-oriented, hands-on understanding of how to apply theoretical concepts to real world problems.</td>
<td>x x x x x</td>
</tr>
<tr>
<td>III. Demonstrated clear communication skills, responsible teamwork, leadership, and professional attitude and ethics.</td>
<td>x x x</td>
</tr>
<tr>
<td>IV. Successfully entered the engineering profession, and embarked on the process of life-long learning in engineering or other professional areas.</td>
<td>x x x</td>
</tr>
</tbody>
</table>

B.4.5.1.4 Evaluating Program Educational Objectives for Achievement

The evaluation of the achievement of program educational objectives requires both a process and data to be used in the process. We define the process as including assessment (“How well are the objectives being achieved?”) and evaluation (“What changes need to be made to enhance the achievement of the objectives?”) to produce enhancement (carrying out the requisite changes leads to increased achievement of the objectives), which is the overall goal.

The overall assessment, evaluation, and enhancement process is visually depicted in Figure B.4.5.1.4.1. It consists of three levels or cycles of improvement processes. The activities of these processes are interlinked and iterative. The goal of the processes is to ensure that the graduates of the program are well prepared to achieve the program educational objectives.

The PEO enhancement process is achieved through the program outcomes enhancement process, which is in turn supported by the process of enhancing individual courses and their vertical integration into the student’s growth in the program. Briefly stated, the achievement of program educational objectives is internally evaluated in terms of the successful achievement of the supporting program outcomes. The success of the students is also evaluated from an external point of view, through the interaction with employers, alumni, the Department Advisory Council and other stakeholders.

Assessing the program outcomes evaluates the degree to which students meet the specified program outcomes performance criteria. The program outcomes achievement is in turn supported by meeting individual course learning objectives while completing the program curriculum.

In order to determine whether the Computer Engineering program is achieving its program educational objectives, and to be able to improve the effectiveness of the program, several different types of data are being collected and used to evaluate the program.
Figure B.4.5.1.4.1 The PEO Assessment Cycle

- Establish and enhance Program Educational Objectives
- Assess the PEO Achievements
- Assess the Program Outcomes Achievements
- Assess the Course Learning Objectives Achievements
- Establish and enhance Program Outcomes
- Establish and enhance Program Learning Objectives

- Institutional mission and goals
- ABET criteria

- Enhance course
- Enhance curriculum

- Student course performance
- Student course feedback

- Senior/Junior feedback
- Student exit focus groups and survey

- Alumni feedback
- Employer feedback

- Advisory Council feedback

- Program delivery

- Program Report
- Outcome Report
- Course Journal

- Self-Study Report v8.doc B.4 Program Educational Objectives
Data used to evaluate the PEOs is derived from the analysis and synthesis of the program outcome reports. The relationship between program educational objectives and program outcomes is depicted in Table B.4.5.1.3.1.

The PEO assessment cycle is based on a number of assessment instruments. The primary ones for assessing PEO achievements (as opposed to the PEOs themselves) are:

- Alumni feedback (surveys and focus groups)
- Employer feedback (surveys and focus groups)
- Outcome reports in relation to the PEOs. (Outcome reports are based in internal assessment processes, see B.6.1.)

The PEO assessment cycle is summarized by the highlighted items in Figure B.4.5.1.4.1.

B.4.5.1.4.1 Alumni Surveys

The program has surveyed alumni two years after graduation. The surveys were designed to test reasonable indicators for each of the four PEOs and asked the following 11 questions:

1. Please list the job titles you have held since graduation. (PEO-IV)
2. Has your work required systematic analysis and design? (PEO-I)
3. Please give some examples (optional). (PEO-I)
4. Please name some tools, methodologies, or equipment that you have used on a regular basis professionally? (PEO-II)
5. How many professional presentations have you given the last 12 months? (PEO-III)
6. Please give some example titles/topics (optional). (PEO-III)
7. How many reports or articles have you written? (PEO-III)
8. Please provide some example titles/topics (optional). (PEO-III)
9. Did you present to or write for people outside the engineering profession? (PEO-III)
10. How many training or university courses have you attended since graduation? (PEO-IV)
11. Please list some of the names or topics (optional). (PEO-IV)

The Spring 2005 results are presented in Table B.4.5.1.4.1.1 (there were 15 respondents). The overall conclusion is that the responding alumni in general meet the program educational objectives. For further commentary and conclusions, see Section B.6.1.
Table B.4.5.1.4.1.1 Summary of Alumni Survey

<table>
<thead>
<tr>
<th>Objective</th>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Has your work required systematic analysis and design?</td>
<td>80% Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7% Sort-of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13% No</td>
</tr>
<tr>
<td>II</td>
<td>Please name some tools, methodologies, or equipment that you have used on a regular basis professionally.</td>
<td>93% Named appropriate tools</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7% Not applicable</td>
</tr>
<tr>
<td>III</td>
<td>How many professional presentations have you given the last 12 months?</td>
<td>Average 3 presentations</td>
</tr>
<tr>
<td></td>
<td>How many reports or articles have you written?</td>
<td>Average 2.5 reports</td>
</tr>
<tr>
<td></td>
<td>Did you present to or write for people outside the engineering profession?</td>
<td>53% Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47% No</td>
</tr>
<tr>
<td>IV</td>
<td>How many training or university courses have you attended since graduation</td>
<td>20% Enrolled in MS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>33% Took 2 to 7 courses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47% None</td>
</tr>
<tr>
<td></td>
<td>Please list the job titles you have held since graduation.</td>
<td>80% discipline-related</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7% Internship</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7% Armed forces</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7% Graduate student</td>
</tr>
</tbody>
</table>

B.4.5.1.4.2 Employer Survey

The program submitted a survey questionnaire to managers of companies in Silicon Valley. The survey was focused primarily on the program outcomes, and through them provides insight into the PEO achievements by way of the linkage of program outcomes to program educational objectives. The survey submitted 20 questions (program outcome listed in parenthesis after each question):

- Consider SJSU computer engineering graduates that you have had professional contact with or supervision of, do they demonstrate (the):
  1. Ability to apply fundamental concepts of mathematics to solving engineering problems (a)
  2. Ability to apply fundamental concepts of science to solving engineering problems (a)
  3. Ability to identify, formulate, and solve engineering problem (b)
  4. Ability to conduct an experiment and give conclusion about the experiment (b)
  5. Ability to design and setup an experiment for a defined objective (b)
  6. Ability to apply engineering specifications to engineering projects (c)
  7. Ability to design a system, component, or process to meet desired needs (c)
  8. Ability to work independently (all)
  9. Ability to function on multi-disciplinary teams (d)
  10. Knowledge of professional and ethical responsibility (f)
  11. Ability to read and write technical reports (g)
  12. Ability to communicate effectively with others (g)
  13. Ability to make oral presentations (g)
  14. Broad education necessary to understand the impact of engineering solutions in a global and societal context (h)
  15. Ability to incorporate economic, environmental, and safety constraints in the design process (h)
  16. Ability and/or initiative to update knowledge and skill (i)
  17. Recognition of the need for life-long learning (i)
  18. Knowledge of contemporary issues (j)
  19. Ability to use modern lab instruments for engineering practice (k)
  20. Ability to use modern software tools for engineering practice (k)

The respondents were asked to provide an answer on a scale from 0 to 4: 4 – Strongly agree, 3-Agree, 2-Somewhat agree, 1-Disagree, 0-Strongly disagree.
Table B.4.5.1.4.2.1 presents the results of 18 respondents in terms of program outcomes and their mapping to education objectives. Sections B.2.9 and B.3.7 provide comments, particularly with respect to PEO IV and outcomes j and k.

**Table B.4.5.1.4.2.1 Summary of Employer Survey**

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
</tr>
<tr>
<td>I</td>
<td>3.3</td>
</tr>
<tr>
<td>II</td>
<td>3.3</td>
</tr>
<tr>
<td>III</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td></td>
</tr>
</tbody>
</table>

**B.4.5.1.4.3 Program Outcome Assessment**

The assessment of program outcomes from Section B.6.1.7 feed into the PEO assessment as well as being of interest in their own right. Table B.4.5.1.4.3.1 shows the summary of the achieved levels of program outcomes in relationship to the program educational objectives for the 2004-05 academic year.

**Table B.4.5.1.4.3 Summary of Achieved Levels of Program Outcomes**

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>I</td>
<td>3</td>
</tr>
<tr>
<td>II</td>
<td>3</td>
</tr>
<tr>
<td>III</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td></td>
</tr>
</tbody>
</table>

- Level 1 – Basic level: knowledge, comprehension
- Level 2 – Intermediate level: application, analysis
- Level 3 – Advanced level: synthesis, evaluation

**B.4.5.1.4.4 Overall Evaluation of Program’s Ability to Achieve Program Educational Objectives**

Based on the alumni survey, employer survey, and program outcome assessment, the students’ ability to achieve the PEOs is summarized as follows:

*Program Educational Objective I – The graduates of the program are prepared to demonstrate an understanding of the fundamental knowledge that is a prerequisite for the practice of computer engineering, including its scientific principles and the importance of rigorous analysis and creative design two to three years after graduation.*

- **Analysis**
  - The alumni survey indicated that students graduating from the program have achieved this objective.
  - The employer survey indicated that the employers in general are satisfied with our students regarding this objective.
  - The program outcome assessment indicated that the students currently in the program are likely to be able to achieve this objective in the future

- **Conclusion**
  - The program has achieved its goals with respect to this objective.

*Program Educational Objective II – The graduates of the program are prepared to demonstrate a practice-oriented, hands-on understanding of how to apply theoretical concepts to real world problems.*

- **Analysis**
  - The alumni survey indicated that students graduating from the program have achieved this objective.
  - The employer survey indicated that the employers in general are satisfied with our students regarding this objective.
The program outcome assessment indicated that the students currently in the program are likely to be able to achieve this objective in the future.

Conclusion
- The program has achieved its goals with respect to this objective.

Program Educational Objective III – The graduates of the program are prepared to demonstrate clear communication skills, responsible teamwork, leadership, and professional attitude and ethics.

Analysis
- The alumni survey indicated that students graduating from the program have achieved this objective to some extent. The fact that close to half the respondents had not addressed a non-engineering audience is likely a reflection of the fact that these are recent graduates who are working primarily with technical management and fellow engineers.
- The employer survey indicated that the employers in general are satisfied with our students regarding this objective. However, the employer focus group indicated that there was room for improvement in the area of communication skills.
- The program outcome assessment indicated that the students currently in the program are likely to be able to achieve this objective in the future.

Conclusion
- The program has achieved its goals with respect to this objective.
- Continue to monitor the communication skills of the students and continue to explore ways to enhance these skills within the context of their coursework.
- Consider engaging graduates further out (5 years) in surveys or focus groups to assess the level of achievement with respect to this PEO.

Program Educational Objective IV – The graduates of the program are prepared to successfully enter the engineering profession, and embark on the process of life-long learning in engineering or other professional areas.

Analysis
- The alumni survey indicated that a majority of the students graduated from the program have successfully entered the engineering profession. It also indicated that 53% of the respondents attend further studies – be it degree-oriented or skills- and profession-oriented. The 47% responding that they have not attended further studies during their first two years after graduation is worthy of note. The number may reflect the downturn in the job market during the period these graduates have been out of school, and the limited opportunities new, young employees have in the current job situation.
- The employer survey indicated that the employers in general are satisfied with our students regarding this objective.
- The program outcome assessment indicated that the students currently in the program are likely to be able to achieve this objective in the future.

Conclusion
- The students graduated from the program have marginally achieved this objective. The percentage of respondents that demonstrate a commitment to continued professional development is satisfactory, but could be improved. This PEO warrants continued attention.
- Consider engaging graduates further out (5 years) in surveys or focus groups to assess the level of achievement with respect to this PEO.
B.5 Program Outcomes and Assessment

B.5.1 Curriculum and Professional Component

B.5.1.1 BS in CMPE

B.5.1.1.1 Program Review

The department, college, and university undergraduate studies committees are responsible for ensuring that the curriculum in the program devotes adequate time and attention to each component of the program and that it is consistent with the objectives of the program and the institution.

All curriculum changes that affect the formal curriculum definition have to be approved by all levels (see Figure B.1.1.1.1). Such changes may be programmatic (e.g., changes in the set of required courses, overall GPA requirements, the prerequisite chains) or course specific (e.g., proposals for new courses, changes in the number of credit hours for a course, in the delivery modes or in the course description).

B.5.1.1.2 Curriculum Content

Table B.5.1.1.2.1 provides a list of the courses in the curriculum and which categories of the professional component they meet.

Table B.5.1.1.2.1 Basic Level Curriculum

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Title</th>
<th>Math and Basic Science</th>
<th>Engineering Topics</th>
<th>General Education</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman Fall</td>
<td>Math 30</td>
<td>Calculus I</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Chem 1A</td>
<td>General Chemistry</td>
<td>5</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Engr 10</td>
<td>Introduction to Engineering</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Engl 1A</td>
<td>Composition I</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oral Communication</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman Spring</td>
<td>Math 31</td>
<td>Calculus II</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phys 70</td>
<td>Mechanics</td>
<td>4</td>
<td></td>
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<tr>
<td></td>
<td>ME 20</td>
<td>Design &amp; Graphics</td>
<td>2</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Engl 1B</td>
<td>Composition II</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Human Understanding &amp; Dev</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sophomore Fall</td>
<td>Math 32</td>
<td>Calculus III</td>
<td>3</td>
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<td></td>
<td>Math 42</td>
<td>Discrete Mathematics</td>
<td>3</td>
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<tr>
<td></td>
<td>Phys 71</td>
<td>Electronics &amp; Magnetism</td>
<td>4</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Human Performance</td>
<td>Physical Education</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>General Education</td>
<td></td>
<td>3</td>
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<tr>
<td></td>
<td>General Education</td>
<td></td>
<td>3</td>
<td></td>
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<tr>
<td>Sophomore Spring</td>
<td>Math 133A</td>
<td>Ordinary Differential Equations</td>
<td>3</td>
<td></td>
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<tr>
<td></td>
<td>CmpE 046</td>
<td>Computer Engineering I</td>
<td>3</td>
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<tr>
<td></td>
<td>EE 98</td>
<td>Intro to Circuit Analysis</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>EE 97</td>
<td>Intro to Circuit Analysis Laboratory</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Human Performance</td>
<td>Physical Education</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>General Education</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>General Education</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junior Fall</td>
<td>Math 129A</td>
<td>Linear Algebra I</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>ISE 130</td>
<td>Engineering Probability &amp; Statistics</td>
<td>3</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Engr 100W</td>
<td>Engineering Reports</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EE 101</td>
<td>Circuit Concepts &amp; Prob Solving</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>CmpE 101</td>
<td>Programming Concepts &amp; Prob Solving</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CmpE 110</td>
<td>Intro to Digital Electronics</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CmpE 124</td>
<td>Digital Design I</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CmpE 126</td>
<td>Algorithm &amp; Data Structure Design</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junior Spring</td>
<td>CmpE 102</td>
<td>Assembly Language</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CmpE 125</td>
<td>Digital Design II</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In the Computer Engineering program, engineering design is distinguished from engineering science in that design involves open-ended problems that have multiple solutions and require the synthesis of many principles for their descriptions and understanding. Design problems require critical thinking and engineering decisions. Students learn to understand the implications of cost, ease of construction, implementation, and user specifications in their final designs. The inclusion of design projects in theoretical courses throughout the curriculum serves to re-enforce the theory with applications.

The student guide provides the complete Computer Engineering program description that is provided to students and is available on the Computer Engineering website. Students in the Computer Engineering program must master mathematics (through differential equations), chemistry for engineers and physics for engineers in order to advance in the program. Their computer engineering courses require this fundamental knowledge and problem solving experience for students to be able to complete the course requirements. The upper division computer engineering courses focus on engineering applications and the major design project provides an experience where concepts that the students have learned in the program are integrated into one project. The Physics, Chemistry and Calculus Task Forces have been working closely with these respective departments to ensure that the topics being covered are appropriate for engineering students and to help them establish an ongoing assessment program.

The curriculum also provides for courses that cover other disciplines related to engineering practice including programming, graphics, mechanics, electrical engineering, fluid mechanics, and material science. In many of the computer engineering courses students are exposed to societal issues, public policy, and ethics. In addition, students are required to take 30 semester units of general education courses in writing, oral communication, humanities, and social science that provide a broad exposure to the types of issues that affect society. In particular, written and oral assignments in ENGR 100W, the junior level technical writing course, require students to analyze and discuss effects of environmental factors as they relate to products, systems and engineering processes.

The curriculum in the Computer Engineering program meets, and in some cases exceeds, the Engineering Criteria. There are 32 credit hours of mathematics and science courses, which meet the requirement of one year of a combination of college level mathematics and basic sciences. Engineering topics cover 51 credit hours, which meets the requirements of one and one half years of engineering topics to include engineering sciences and engineering design. The 32 units of general education courses complement the program and are consistent with the detailed general education plan established by the university.

A four member undergraduate studies committee is elected annually to make initial decisions and recommendations regarding undergraduate curriculum matters. Specifically this committee recommends approval of new courses (including ad hoc special topic offerings), significant changes to individual courses, and periodic reviews of the entire curriculum. Individual faculty members are encouraged to meet with the Undergraduate Studies Committee to initiate ideas for specific new courses or directions.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CmpE 127</td>
<td>Microprocessor Design I</td>
<td>3</td>
</tr>
<tr>
<td>CmpE 130</td>
<td>File Processing</td>
<td>3</td>
</tr>
<tr>
<td>CmpE 142</td>
<td>Operating System Design</td>
<td>3</td>
</tr>
<tr>
<td>CmpE 131</td>
<td>Software Engineering I</td>
<td>3</td>
</tr>
<tr>
<td>Senior</td>
<td>CmpE 140</td>
<td>3</td>
</tr>
<tr>
<td>Fall</td>
<td>CmpE 152</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CmpE 195A</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Technical Elective</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Technical Elective</td>
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</tr>
<tr>
<td></td>
<td>Advanced General Education</td>
<td>3</td>
</tr>
<tr>
<td>Senior</td>
<td>ME 109</td>
<td>3</td>
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<tr>
<td>Spring</td>
<td>CmpE 195B</td>
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<tr>
<td></td>
<td>Technical Elective</td>
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</tr>
<tr>
<td></td>
<td>Advanced General Education</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Unit Hours: 133
B.5.1.1.3 Preparation for Engineering Practice
The BS in CMPE curriculum stresses problem solving and design skills. Students take a sequence of core courses in both computer software and computer hardware. In each of these courses, the students learn fundamental concepts and apply these to short design exercises. The students are required to work in teams on projects and laboratory exercises.

Students also take three technical electives that allow them to explore one or two computer engineering areas in depth, or to take advanced courses in multiple computer engineering areas. Students intending to attend graduate school, often choose to explore one area in depth.

While many of the engineering courses require oral presentations or written reports, four upper division courses have been identified as having extensive communication components to ensure that students are given opportunities to perfect their skills (ENGR 100W, Engineering Reports; CMPE 131, Software Engineering; CMPE 195A and B, Senior Project). Professional and ethical issues are discussed in many courses, but specific curricular units on these topics are provided in ENGR 100W, and CMPE 195A and B. The department actively provides students with leadership opportunities through its support of the Society for Computer Engineers. This local student group has over 200 members and sponsors many invited speakers from the Silicon Valley. In addition, the College of Engineering supports the Society of Women Engineers, Black Alliance of Scientists and Engineers, Society of Latino Engineers and Scientists, and Tau Beta Pi, and students are encouraged to join these societies. Professors also take students with them to attend monthly meetings of professional societies (ACM, IEEE, etc.)

The computer engineering curriculum provides students with a diverse design experience and exposure to the design issues and solutions in the many professional areas of computer engineering. This is consistent with the program objectives of preparing students for professional practice.

There are 16 required laboratory courses in the computer engineering curriculum (PHYS 70, PHYS 71, CHEM 1A, ENGR 10, CMPE 46, CMPE 101, CMPE 110, CMPE 124, CMPE 125, CMPE 127, CMPE 131, CMPE 140, CMPE 152, EE 97 and CMPE 195A & B.). These courses require students to perform experiments, design aspects of experiments, and interpret data. Students learn how to collect data, analyze data, and interpret the data in order to draw conclusions and communicate their results through oral and written presentations. Reviewing course materials allows for an assessment of this component.

Design activities are integrated into courses throughout the program curriculum. Design projects are first introduced in preliminary forms in introductory courses and these concepts are continually built upon throughout the curriculum, culminating in major complex projects in advanced courses. For example, in ENGR 10 students participate in three comprehensive design projects. In each of these projects, they work in teams to design a product (system, component, or process) that meets a set of criteria (specifications). They present their results in written reports as well as in oral presentations. In at least one of these projects, students have to build the product and test it to verify its performance. Examples of such projects include (a) the design and manufacture (using limited materials) of a cup to keep coffee hot for as long as possible, and (b) the design of a rubber-powered airplane for maximum range and endurance. Most computer engineering courses have several design examples and/or projects. For example CMPE 127, Microprocessor Design I, has the students design and build a complete microprocessor system. In CMPE 131, Software Engineering, the students complete several large-scale software design projects. Contemporary issues are discussed in many courses in the program and students also attend seminars through the professional societies and student organizations. The senior capstone course, CMPE 195A and B, has a seminar series that covers many contemporary issues specifically relating to teamwork, ethics, and life as a practicing engineer.

As a computing discipline, the program requires the study and use of computers in some form or another throughout the entire program. The facilities section B.8 discusses the extensive computing laboratories available to the students.

The program meets the ABET criteria. Evidence that will be available to show achievement of Criterion 4: Professional Component includes:

- Course journals
• Outcome reports
• Samples of student work in all engineering and science courses
• Interviews with students
• Transcripts
• Summary of the graduating student survey results

B.5.1.2 MS in CMPE Program

B.5.1.2.1 Program Review

The department, college, and university undergraduate studies committees are responsible for ensuring that the curriculum in the program devotes adequate time and attention to each component of the program and that it is consistent with the objectives of the program and the institution.

All curriculum changes that affect the formal curriculum definition have to be approved by all levels. Such changes may be programmatic (e.g., changes in the set of required courses, overall GPA requirements, the prerequisite chains) or course specific (e.g., proposals for new courses, changes in the number of credit hours for a course, in the delivery modes or in the course description).

B.5.1.2.2 Curriculum Content

Total 30 units with additional 3 units of technical writing if necessary.

Current curriculum Content

Degree Core (6 units)
  CMPE 200 & CMPE 220
Specialization Core (9 units)
  Courses approved by the graduate coordinator
Technical Electives (9 or 12 units)
  Courses approved by the graduate coordinator
Projects/thesis (3 or 6 units)
  CMPE 295 (3 units), CMPE 295A&B (6 units), or CMPE 299 (6 units of thesis)
Technical Writing (3 units)
  CMPE 294 or ENGR 200W

Curriculum Content to be implemented in Fall 2007

Degree Core (6 units)
  CMPE 200 & CMPE 220
Specialization Core (9 units)
  Three courses from one of the following specializations
    System Design - CMPE 212, 240, 264, 213, 211
    Network Systems - CMPE 206, 207, 208, 209
    Embedded Systems - CMPE 240, 242, 297AA, 244, 261
    Secure Systems - CMPE 209, 287, 297T
Technical Electives (9 units)
  Courses approved by the graduate coordinator
Projects/thesis (6 units)
  CMPE 295A&B (project), or CMPE 299 (thesis)
Technical Writing (3 units)
  CMPE 294 or ENGR 200W
B.5.1.2.3 Preparation for Engineering Practice

The MS Computer Engineering program requires 30 semester units of course work beyond a B.S. degree in computer engineering, electrical engineering or computer science. The graduate program is designed to provide computer engineers and computer scientists with advanced concepts and corresponding skill-sets in all areas of computer engineering.

In order to ensure the adequate foundation for studying advanced topics, two core course (CMPE 200 and 220) must be satisfactorily completed by all MS in CMPE students.

CMPE 200 covers the computer architecture related topics such as mapping assembly language instructions to hardware operations, enhancements of the basic pipelined architecture, etc. CMPE 220 covers system software related topics such as concepts and methods in designing various types of system software, the relationships between machine architecture and system software, as well as designing and implementing system software projects.

Four specializations are provided that lead to a MS in CMPE degree: System Design, Network Systems, Embedded Systems, and Secured Systems.

The System Design specialization prepares students to become technical leaders in the rapidly changing computer system development environment. It offers an education in the fundamentals of computer system development and in-depth exposure to the latest technologies and trends in digital and computer system design (CMPE 212, 264), advanced microcomputer design (CMPE 240), memory design (CMPE 211) and parallel processing design (CMPE 213).

The Network Systems specialization provides current and future computer professionals with the essential skills and real-world knowledge to succeed in the computer engineering field. It offers an education in the fundamentals of computer engineering and an in-depth exposure to the latest technologies and trends in computer network system design with courses in network design (CMPE 206), network programming (CMPE 207), network protocol (CMPE 208), and network security (CMPE 209).

The Embedded Systems specialization provides a unique opportunity to computer engineers in the area of embedded system design. Through a combination of basic-concept courses and hands-on experience, students learn the fundamentals as well as the design, development, and implementation of embedded systems through a series courses consisting of embedded hardware design (CMPE 242), embedded software design (CMPE 244), wireless embedded system design (CMPE 297AA), and real-time computer systems (CMPE 261).

The Secured Systems specialization prepares students with skills to engage in designing secured computer systems. Students learn the fundamentals as well as the design, development, and implementation of secured systems through a series courses such as software secured technologies (CMPE 297T), network security (CMPE 109), and software quality assurance (CMPE 287).

Students integrate all their skills in a year-long master project or thesis sequence of courses (CMPE 295A&B or CMPE 299) as they undertake an individual or team-based design project. These courses engage students in the practices that cover the entire process of problem formation, design, implementation and validation at both component and system level, to solve real-life problems.

B.5.1.3 BS in SE Program

B.5.1.3.1 Program Review

The department, college, and university undergraduate studies committees are responsible for ensuring that the curriculum in the program devotes adequate time and attention to each component of the program and that it is consistent with the objectives of the program and the institution.
All curriculum changes that affect the formal curriculum definition have to be approved by all levels. Such changes may be programmatic (e.g., changes in the set of required courses, overall GPA requirements, the prerequisite chains) or course specific (e.g., proposals for new courses, changes in the number of credit hours for a course, in the delivery modes or in the course description).

### B.5.1.3.2 Curriculum Content

Table B.5.1.3.2.1 provides a list of the courses in the curriculum and which categories of the professional component they meet.

#### Table B.5.1.3.2.1 Basic Level Curriculum

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Title</th>
<th>Math and Basic Science</th>
<th>Engineering Topics</th>
<th>General Education</th>
<th>Other</th>
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</thead>
<tbody>
<tr>
<td>Freshman Fall</td>
<td>Math 30</td>
<td>Calculus I</td>
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<tr>
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<td>Engl 1A</td>
<td>Composition I</td>
<td>3</td>
<td></td>
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<tr>
<td></td>
<td>AMS 1A</td>
<td>American Studies</td>
<td>6</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Oral Communication</td>
<td></td>
<td>3</td>
<td></td>
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<tr>
<td></td>
<td>Human Performance</td>
<td></td>
<td>1</td>
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<td>Calculus II</td>
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<td></td>
<td>Phys 70/Phys 50</td>
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<td>4</td>
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<td></td>
<td>Math 42</td>
<td>Discrete Mathematics</td>
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<tr>
<td></td>
<td>Engl 1B</td>
<td>Composition II</td>
<td>3</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>CS 46A</td>
<td>Introduction to Programming</td>
<td>4</td>
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<tr>
<td>Sophomore Fall</td>
<td>Math 129A</td>
<td>Linear Algebra I</td>
<td>3</td>
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<tr>
<td></td>
<td>Phys 71/Phys 51</td>
<td>Electronics &amp; Magnetism</td>
<td>4</td>
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<tr>
<td></td>
<td>AMS 1B</td>
<td>American Studies</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CS 46B</td>
<td>Introduction to Data Structures</td>
<td>4</td>
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<tr>
<td>Sophomore Spring</td>
<td>Math 32</td>
<td>Calculus III</td>
<td>3</td>
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<td></td>
<td>CmpE 131</td>
<td>Software Engineering I</td>
<td>3</td>
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<tr>
<td></td>
<td>CS 146</td>
<td>Data Structures and Algorithms</td>
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<td>CmpE 120</td>
<td>Computer Organizations and Architecture</td>
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<tr>
<td></td>
<td>Human Understanding &amp; Dev</td>
<td></td>
<td>3</td>
<td></td>
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<tr>
<td></td>
<td>Human Performance</td>
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<tr>
<td>Junior Fall</td>
<td>Math 133A/Math 142</td>
<td>Ordinary Differential Equations</td>
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<td></td>
<td>CmpE 104</td>
<td>Fundamental of Software Engineering</td>
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<td></td>
<td>CmpE 148</td>
<td>Computer Networks I</td>
<td>3</td>
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<td>ISE 130/Math 161A</td>
<td>Engineering Probability &amp; Statistics</td>
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<td></td>
<td>Engr 100W/CS 100W</td>
<td>Engineering Reports</td>
<td>3</td>
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<td></td>
<td>Advanced General Education</td>
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<td>Junior Spring</td>
<td>CS 149</td>
<td>Operating Systems</td>
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<tr>
<td></td>
<td>ISE 164</td>
<td>Computer and Human Interaction</td>
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<td>CS 157A</td>
<td>Intro to Database Management Systems</td>
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<td></td>
<td>CS 166</td>
<td>Information Security</td>
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<td></td>
<td>CmpE 135</td>
<td>Object-Oriented Analysis and Design</td>
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<td>Senior Fall</td>
<td>CS 157B</td>
<td>Database Management Systems II</td>
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<td></td>
<td>SE 195A</td>
<td>Senior Software Engineering Project</td>
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<td></td>
<td>Cmpl 137</td>
<td>Wireless Mobile Software Engineering</td>
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<td></td>
<td>CS 152</td>
<td>Programming Paradigms</td>
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<td></td>
<td>CmpE 133</td>
<td>Software Engineering II</td>
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<td>Technical Elective</td>
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<td>Senior Spring</td>
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<td>Software Engineering Process Management</td>
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<td>SE 195B</td>
<td>Senior Software Engineering Project II</td>
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<td></td>
<td>CmpE 187</td>
<td>Software Quality Testing</td>
<td>3</td>
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</tr>
</tbody>
</table>
B.5.1.3.3 Preparation for Engineering Practice

The software engineering curriculum stresses problem solving and design skills. Students take a sequence of core courses in both computer engineering and computer science. In each of these courses, the students learn fundamental concepts and apply these to short design exercises. The students are required to work in teams on projects and laboratory exercises.

Students also take two technical electives that allow them to explore one or two software engineering areas in depth. Students intending to attend graduate school, often choose to explore one area in depth.

While many of the engineering courses require oral presentations or written reports, four upper division courses have been identified as having extensive communication components to ensure that students are given opportunities to perfect their skills (ENGR 100W, Engineering Reports; CMPE 131, Software Engineering; SE 195A and B, Senior Project). Professional and ethical issues are discussed in many courses, but specific curricular units on these topics are provided in ENGR 100W, and SE 195A and B. The College of Engineering supports the Society of Women Engineers, Black Alliance of Scientists and Engineers, Society of Latino Engineers and Scientists, and Tau Beta Pi, and students are encouraged to join these societies. Professors also take students with them to attend monthly meetings of professional societies (ACM, IEEE, etc.)

The software engineering curriculum provides students with a diverse design experience and exposure to the design issues and solutions in the many professional areas of software engineering. This is consistent with the program objectives of preparing students for professional practice.

Almost all CMPE courses require students engage in course projects to perform experiments, design aspects of experiments, and interpret data. Students learn how to collect data, analyze data, and interpret the data in order to draw conclusions and communicate their results through oral and written presentations. Reviewing course materials allows for an assessment of this component.

Design activities are integrated into courses throughout the program curriculum. Design projects are first introduced in preliminary forms in introductory courses and these concepts are continually built upon throughout the curriculum, culminating in major complex projects in advanced courses.

As a software engineering discipline, the program requires the study and use of computers in some form or another throughout the entire program. The facilities section B.8 discusses the extensive computing laboratories available to the students.

B.5.1.4 MS in SE Program

B.5.1.4.1 Program Review

The department, college, and university undergraduate studies committees are responsible for ensuring that the curriculum in the program devotes adequate time and attention to each component of the program and that it is consistent with the objectives of the program and the institution.

All curriculum changes that affect the formal curriculum definition have to be approved by all levels. Such changes may be programmatic (e.g., changes in the set of required courses, overall GPA requirements, the prerequisite chains) or course specific (e.g., proposals for new courses, changes in the number of credit hours for a course, in the delivery modes or in the course description).

B.5.1.4.2 Curriculum Content
Total 30 units with additional 3 units of technical writing if necessary.

Degree Core (9 units)
CMPE 202, 203 & 272

Specialization Core (6 units)
Enterprise Software Technologies - CMPE 273, 275
Software Systems Engineering - CMPE 285, 287
Networking Software – CMPE 206, 207

Technical Electives (9 units)
Courses approved by the graduate coordinator

Projects/thesis (6 units)
CMPE 295A&B (6 units), or CMPE 299 (6 units of thesis)

Technical Writing (3 units)
CMPE 294 or ENGR 200W

B.5.1.4.3 Preparation for Engineering Practice

The MS in SE program provides students with an educational experience that builds on traditional computer science and engineering, and then takes an integrative approach to software engineering. With the increased globalization of the software development workforce there is less programming being performed in the United States. Therefore it becomes increasingly important that graduates understand developing technologies and architectures and their influence on software engineering processes, where large-scale design is pre-eminent, and where component integration is the standard mode of development. The program offers a strong testing and quality assurance component.

The software industry increasingly requires those with a suitable engineering background for their cutting edge projects. Graduates with an MS in SE can expect to find significant opportunities in software development, management, and marketing.

A wide variety of computing equipment is available. Courses are usually conducted using the specialized equipment at the department, with a variety of sophisticated workstations and state-of-the-art software engineering tools.

In order to ensure the adequate foundation for studying advanced topics, three core course (CMPE 272, 202, and 203) must be satisfactorily completed by all MS in SE students. CMPE 272 is an introduction to enterprise software systems. CMPE 202 applies an integrated approach to introduce software systems development methodologies and processes. CMPE 203 covers the management perspectives of developing software systems.

Three specializations are provided that lead to a Masters of Science in Software Engineering degree: Enterprise Software Technologies, Software Systems Engineering, and Networking Software.

The Enterprise Software Technologies specialization prepares students to become technical leaders in the rapidly changing software development environment. It offers an education in the fundamentals of software development and in-depth exposure to the latest technologies and trends in enterprise software development. It prepares students for technical careers in infrastructure software and enterprise application development.

The Software Systems Engineering specialization provides current and future software professionals with the essential skills and real-world knowledge to succeed in the software engineering field. It offers an education in the fundamentals of software engineering and an in-depth exposure to the latest technologies and trends in software development processes, methodologies, and tools. Teamwork is emphasized throughout the curriculum to provide students with essential preparation for working in the industry.

The Networking Software specialization provides a unique opportunity to software engineers in the area of networking and distributed systems. Through a combination of basic-concept courses and hands-on experi-
ence, students learn the fundamentals as well as the design, development, and implementation of networking and the impact of networking on distributed systems.

Students integrate all their skills in a year-long master project or thesis sequence of courses (CMPE 295A&B or CMPE 299) as they undertake an individual or team-based design project. These courses engage students in the practices that cover the entire process of problem formation, design, implementation and validation at both component and system level, to solve real-life problems.
B.5.2 Program Outcomes and Assessment for BS in CMPE

B.5.2.1 Program Outcomes

The BS in Computer Engineering program is designed to produce computer engineering graduates who have attained:

(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.

It will be noted that these outcomes are the same as those defined in ABET Criterion 3. The faculty considered the ABET list in detail, and decided that the list as provided and described was sufficiently comprehensive and clearly stated to meet the needs of the Computer Engineering program. Table B.4.5.1.3.1 shows how the computer engineering program outcomes support the program educational objectives.

Figure B.5.2.2.1 provides a visualization of our overall assessment process with those items contributing to the assessment cycle of the program outcomes highlighted.

B.5.2.2 Program Outcomes Assessment

As a result of an evaluation of the assessment process in the first half of the six year cycle described in Figure B.4.5.1.1.1 the assessment process was refined: The PEOs and program outcomes act as the basis upon which the curriculum is built and sustained. Using the concepts of continuous improvement (which is itself taught in several courses), the curriculum is scrutinized at both the content level and the course delivery level to assure quality in the program.

Several procedural mechanisms are in place to assure that the program outcomes are monitored effectively.

Figure B.2.1.1.1 provides a visualization of our overall assessment process, including program-, and course-level assessment and enhancement cycles (highlighted in Figure B.5.2.2.1).
Figure B.5.2.2.1 The Program Outcome Assessment Cycle

- Establish and enhance Program Educational Objectives
- Assess the Program Educational Objectives Achievements
- Establish and enhance Program Learning Objectives
- Assess the Course Learning Objectives Achievements
- Program Report

- Establish and enhance Program Outcomes
- Assess the Program Outcomes Achievements
- Program Outcome Report

- Enhance course
- Enhance curriculum

- Student course performance
- Student course feedback

- Senior/Junior feedback
- Student exit focus groups and survey

- Alumni feedback
- Employer feedback

- Institutional mission and goals
- ABET criteria
Through this process, we assess and assure that computer engineering graduates have achieved the program outcomes. Program educational objectives are achieved primarily through the curriculum (technical and general education) by the design and control of the contributions made by individual courses as well as their (“vertical”) integration into a cumulative growth for the student. The following discussion describes the assessment plan in detail, including assessment of the curriculum (technical and general education), and its integration into assessment of achievement of program outcomes.

B.5.2.2.1 Assessment Process

The assessment cycle of course learning objectives is depicted in Figure B.5.2.2.1.1. A pilot evaluation was conducted for testing the assessment system of the program outcomes by using a limited sampling of courses, student work and constituent data. The initial implementation and testing of the assessment process identified several important lessons that led to system revisions/clarifications, and the start of an educational process for the faculty:

1. A clearly understood relationship and flow must occur from course learning objectives through program outcomes to PEOs. All course syllabuses now provide a correlation of student learning goals through course learning objectives and a connection to the program outcomes.

2. Department faculty must have a common understanding of what constitutes well-conceived and well-written objectives at the course and program levels. A great deal of faculty discussion and consideration was given to the connections between course contents and learning objectives, and of distinguishing among the department, program and course levels.

3. Outcomes performance criteria must be accompanied with metrics of achievement. After several department meetings, a two-category (achieved and to-be-improved) and three-level achievement (basic, intermediate, and advanced) metrics was adopted.

The process itself of designing, implementing and testing the assessment system has led to assessing the need for the faculty developing common concepts and terminology, adopting a constituent-driven evaluation process, and focusing on student learning (and its measurement).

The goal is to complete an evaluation of all program outcomes every year. An outcome champion will be assigned and responsible for organizing the collection of materials needed for the evaluation. This involves giving guidance to the faculty about what is needed to complete the assessment. A stratified random sampling technique is used to ensure that materials from the entire spectrum of students are used in the assessment. All members of the team assess each sample.
Figure B.5.2.2.1.1 The Course Learning Objective Assessment Cycle
B.5.2.3 Assessment of the Technical Curriculum by Program Faculty

The Computer Engineering program outcome assessment and enhancement process through course learning objective assessment is visualized in Figure B.2.1.1.1 with those items contributing to the course learning objective assessment are highlighted. The primary supporting materials for the process consist of course journals, student work collected from the various courses, and constituency assessment materials. Particular emphasis is placed on the integrative experience of the student who is longitudinally tracked from entry through employment.

B.5.2.3.1 Course Journal

A course journal is constructed, for all required courses and select elective course, to serve two purposes:

- **Course Improvement**: By documenting a set of requirements for course content encompassed in course learning objectives, evaluation indicators for these objectives encompassed in learning performance indicators, and achievement levels for each, it promotes consistency, quality and dependability for the course, regardless of who is teaching it. Course assessment results for the achievement of course learning objectives are used to identify where and how improvements can be made to enhance student learning.

- **Evaluation of Outcome Support**: By documenting a set of requirements for assessable components, and contributions to program outcomes and combined with student work and feedback collected from the course, it is used as a source for assessing student achievement with regard to program outcomes.

The course journal characterizes the contributions the course is intended to make to student learning and progression towards the program outcomes. To assess the extent to which the course delivery succeeds, student work is collected from a sampling of students of all passing grade levels. Assessment of the student work together with the course journal is used to evaluate and improve the course and also to evaluate and improve the course’s contribution to Program outcomes as it is integrated into the curriculum. A course journal consists of four sections: course description, course modifications, course assessment, and assessment data.

B.5.2.3.1.1 Course Description

The course description includes the syllabus, an explanation of the significance of the course learning objectives and a course assessment matrix.

- **Syllabus**: describes the CLOs, the course content, the course conduct.
- **Significance of Course Learning Objectives**: includes a table to describe the relationships of CLOs to POs. The relationships are represented in content capability levels. There are three categories of content capability levels:
  - Level 1 – Basic level: knowledge, comprehension
  - Level 2 – Intermediate level: application, analysis
  - Level 3 – Advanced level: synthesis, evaluation
- **Course Assessment Matrix**: describes the CLOs, Learning Performance Indicators (LPIs), assessment methods, prerequisites, and content levels. LPIs are indicators associated with a particular CLO that can be evaluated using designated assessment methods to indicate student performance. All LPIs for a particular CLO are used to make the assessment of achievement for that CLO. The assessment methods are categorized as follows:
  - E – Exam and test
  - F – Stakeholder feedback
  - H – Homework assignment
  - J – Project
  - L – Laboratory assignment
  - P – Presentation
  - R – Report
  - S – Survey
X – Exit survey  
O – Others

B.5.2.3.1.2 Course Modifications

Based on the actions recommended as a result of previous course assessments, the modifications of a course are summarized in the following categories.

- Changes to course learning objectives
- Changes to course content
- Changes to laboratory
- Changes to textbook
- Changes to prerequisites
- Others

B.5.2.3.1.3 Course Assessment

After each semester, a summary of content levels and assessment capability levels for each course learning objective is summarized in a table. Furthermore the following areas related to each courses are assessed:

- **Assessment of student learning capability levels:** each “to be improved” learning performance indicator consists of a description of data sources, analysis statements, and action items with individual tracking identifications
- **Assessment of student performance:** includes a summary, a comparison with overall departmental student grades, a comparison with previous student grades, an analysis of the trend, and a list of actions with tracking identifications.
- **Assessment of student feedback:** includes a summary, a comparison with overall departmental student survey, a comparison with previous student course feedback of each course learning objectives, an analysis of each to be improved course learning objective, and a list of actions with tracking identifications.
- **Assessment of other feedback**
- **Summary of actions:** includes an action id, description, implementation, and status of each action related to the course.

B.5.2.3.1.4 Assessment Data

The data pertinent to the assessment of each course is included in this section. The data is presented in the following sequence.

- Exams and tests
- Homework assignments
- Laboratory assignments
- Presentations
- Reports
- Projects
- Student feedback
- Stakeholder feedback
- Others

B.5.2.3.2 Outcome Report

The department faculty members have identified the courses chosen as primary supporting courses for each program outcome. Faculty members have also subscribed as the outcome champions for each program outcome. Each outcome champion uses course journals and additional materials to assess the extent of the achievement of the specific program outcome. The process is organized and described in the outcome report developed by individual outcome champion. Each outcome report contains materi-
B. PROGRAM PLANNING REVIEW REPORT

als of various program outcome assessment methods (surveys of various constituents, student course-work results) and materials showing how individual courses link to the program outcome.

Each outcome champion develops the program outcome context from the program’s perspective. Each outcome champion also develops a road map that describes the expected “vertical” integration, i.e., freshman through senior year, of course contributions supporting achievement of a program outcome’s performance criteria. The outcome champion assesses achievement of the program outcome by evaluating constituent assessment results, the collected student work, and the course journal materials in light of the road map and specified performance criteria. Having determined the extent to which the program outcome was achieved by the cumulative curriculum, the outcome champion evaluates and recommends changes for the purpose of increasing achievement, which are discussed and approved or revised by the whole faculty. The department implements the approved changes to achieve program (and course) enhancement. The program outcome report includes the road map and provides an historical summary of overall assessment results, evaluation results and enhancement plans and their implementation.

Based on the course journals and in conjunction with additional assessment data, a report is developed for each of the eleven program outcomes. Each outcome report consists of following sections:

B.5.2.3.2.1 Operational Definition of the Outcome

It describes the measurement criteria of student’s capability level in order to fulfill the requirements of the outcome.

B.5.2.3.2.2 Curriculum Progression towards the Outcome

It is a road map that describes the expected “vertical” integration of the program outcome from multiple course categories. It includes the following sections:

• Program summary
• Preparation courses
• Engineering core courses
• Degree required courses

B.5.2.3.2.3 Course to Program Outcome Assessment

It is a matrix to describe the course type, assessment methods, content level, and assessed capability level of each course applicable to the outcome.

<table>
<thead>
<tr>
<th>Course type</th>
<th>Content level</th>
</tr>
</thead>
<tbody>
<tr>
<td>P – Preparation</td>
<td>1 – Knowledge, comprehension, or basic level</td>
</tr>
<tr>
<td>C – Engineering core</td>
<td>2 – Application, analysis, or intermediate level</td>
</tr>
<tr>
<td>R – Degree required</td>
<td>3 – Synthesis, evaluation, or advanced level</td>
</tr>
<tr>
<td>E – Degree elective</td>
<td>Assessed capability level</td>
</tr>
<tr>
<td>G – General education</td>
<td>A – Adequate (above or meets expectation)</td>
</tr>
<tr>
<td></td>
<td>I – To be improved (below expectation)</td>
</tr>
<tr>
<td></td>
<td>U – Covered but not assessed</td>
</tr>
</tbody>
</table>

B.5.2.3.2.4 Outcome Assessment and Recommended Actions

An assessment summary of the program is given with data sources, analysis, and action items. Detailed assessment and recommended actions are described in the following course blocks:

• Preparation courses
• Engineering core courses
• Required major courses

B.5.2.3.2.5 Basis for Assessment

This section provides data extracted from:
B.5.2.3.3 Status of the Assessment Process
The second generation assessment process has been defined and implemented.
The status of this second iteration at the time of the self-study is as follows:
• The described system has been installed.
• Course journals and outcome reports together with their supporting material have been developed.
• Student work has been collected from all primary supporting curriculum courses.
• Constituency evaluations have been collected and analyzed.
• Outcomes assessment has been performed to evaluate the process and to provide assessment results.
• The results of the program outcome assessment process have led to revisions of the process as well as early enhancement of the program through course enhancements.
The course journals and outcome reports with their supporting materials will be available at the site visit, as will the collected student work.
The constituency feedback to date are reported in Section B.5.1. Section B.1.1 describes the program enhancements that have been undertaken as a result of the feedback as well as other evaluative processes and discussions that have played a part in this process.

B.5.2.4 Assessment of the Technical Curriculum by Industry Representatives
Some senior projects are sponsored and reviewed by industry partners. Volunteers from the engineering industry have performed course assessments. Each industrial representative completes the following tasks:
• Reviews the design project statement for content and realistic constraints,
• Attends design labs to assist students with designs,
• Attends presentations of final designs and other deliverables (prototypes) and evaluate student groups,
• Provides feedback to the faculty members for improvement.

B.5.2.5 Laboratory Assessment
Teams that include representatives from local industry provided a laboratory assessment (both physical space and course support). The teams consist of members of the Department Advisory Council and additional volunteers. The process consists of a visit to the laboratory at which the team is introduced to the activities, the equipment, and plans for future upgrades. Final recommendations are made regarding the quality of the experiments, the quality of the documentation and the quality of the equipment. The results of the assessment are used to evaluate curriculum content as well as assist in setting priorities for laboratory development.
As a result of such visits, the department has received equipment donations from Apple Computers, Cadence, Intel and Xilinx.

B.5.2.6 Assessment of General Education

B.5.2.6.1 General Education Contributions to Engineering Outcomes
The General Education Program Guidelines define the overall goals of General Education (GE) program, which are in line with the SJSU Mission and goals. The GE program goals are:
• To develop analytical skills and reasoning powers.
• To increase the ability to communicate ideas effectively both in speaking and in writing.
• To enhance the ability to live and work intelligently, responsibly, and cooperatively in a multicultural society and an increasingly interdependent world.
• To provide a fundamental understanding of science and the natural world.
• To further knowledge and appreciation of the arts and letters.
• To promote citizenship through knowledge of the forces that shape the individual and modern society.
• To develop abilities to address complex issues and problems using disciplined analytic skills and creative techniques.

The GE goals overlap significantly with the ABET outcomes, in particular with the following outcomes:
(d) an ability to function on multi-disciplinary teams
(f) an understanding of professional and ethical responsibilities
(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

The GE program consists of the Core and Advanced course. Core GE courses target such skills as oral communication, written communication, critical thinking, and math concepts. Advanced GE courses have as prerequisites completion of Core GE and a junior-level Writing Skills Test. The four Advanced GE Areas are:
Area Z. Written Communication II (100W, known as Engineering Reports)
Area R. Earth and Environment
Area S. Self, Society and Equality in the United States
Area V. Culture, Civilization and Global Understanding

B.5.2.6.2 General Goals of Advanced GE

Within the Advanced GE areas, students in all majors are called upon to demonstrate certain skills and competencies judged to be important to an educated person in today’s society. All courses in these four areas must build upon the skills and knowledge base of the Core GE. The four Advanced GE areas complement education in the individual majors by assuring:

✧ **Advanced Writing.** The 100W courses require a minimum of 8,000 words, and each of the other three Advanced Areas a minimum of 3,000 words. In both instances, “practice and feedback..” are required; thus simply turning in an end-of-semester term paper does not satisfy the GE requirement.

✧ **Interdisciplinary Perspectives.** All Advanced GE courses must consider issues from different academic disciplines.

✧ **Application of basic skills.** All Advanced GE courses demand that students use core GE skills (reading, writing, speaking, critical thinking, research, and math).

✧ **Active participation.** All Advanced GE courses require active student participation.

✧ **Research.** All Advanced GE courses require students to utilize library research (broadly interpreted to include contemporary electronic information sources). Class study materials must include primary sources.

Table B.5.2.6.2.1 summarizes the contributions of the GE program to outcomes d, f, g, h, i and j. All GE areas include area goals and specific student learning objectives. Every GE course that is certified must provide evidence that students demonstrate achievement of the learning objectives as discussed in the section on GE certification and assessment.

<table>
<thead>
<tr>
<th>Table B.5.2.6.2.1: Contributions of GE Areas to ABET Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome</strong></td>
</tr>
<tr>
<td>(d) an ability to function on multi-disciplinary teams.</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Z – Written Communication

(f) an understanding of professional and ethical responsibility.
   A1 – Oral Communication
   A2 – Written Communication 1A
   E – Human Understanding and Development
   S – Self, Society & Equality

(g) an ability to communicate effectively
   A1 – Oral Communication
   A2 – Written Communication 1A
   C3 – Written Communication 1B
   Pass the writing skills test
   S – Self, Society & Equality
   V – Culture, Civilization and Global Understanding
   Z – Written Communication

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
   B1, B2 – Science
   C1 – Arts
   C2 – Letters
   D1, D2, D3 – Social Sciences
   R – Earth and Environment
   S – Self, Society & Equality
   V – Culture, Civilization and Global Understanding

(i) a recognition of the need for, and an ability to engage in life-long learning
   B1, B2 – Science
   B4 – Mathematical Concepts
   C3 – Written Communication 1B
   E – Human Understanding and Development
   S – Self, Society & Equality
   V – Culture, Civilization and Global Understanding
   Z – Written Communication

(j) a knowledge of contemporary issues
   D1, D2, D3 – Social Sciences

B.5.2.6.3 Course Certification and Assessment

GE courses go through a detailed planning and review process. Prior to the establishment of a new course, the faculty must submit a proposal that includes learning objectives, a syllabus, and an assessment plan. Assessment of GE student learning outcomes is based on course-specific assignments and activities rather than standardized tests. The plans typically specify which activities, assignments, and exams will be used to assess each of the General Education objectives. Occasionally a plan also includes pre-and post-tests or surveys. All Core GE courses are reviewed by area-specific General Education Advisory Panels (GEAPs), each of which is made up of six or seven faculty members from several colleges. Advanced GE courses are reviewed by the ten-member Board of General Studies (BOGS). The recommendations of the GEAPs are advisory and all final decisions are made by the BOGS. The GEAPs and the BOGS incorporate more than 80 faculty members in the review and assessment process.

Following review, the BOGS gives an initial certification of up to two years for approved courses. Then, based on the approved assessment plans, faculty collect data on student performance related to general education learning objectives. The course coordinator submits a Coordinator Summary Form that summarizes assessment methods, student performance related to each learning objective, and course modifications based on the assessment aimed at improving student learning for all sections of the course that are taught. After review of the coordinator report, the BOGS certifies courses for up to four more years depending on the results of the two-year assessment. Certified courses are reviewed every two to four years (depending on the level of certification). When members of the BOGS identify concerns about how courses are meeting student learning objectives, a process is in place where course coordinators meet with BOGS members or with a faculty-in-residence at the Center for Faculty Development to help identify effective improvements to the course.

As of February 2004, 260 courses had been submitted for initial certification under the 1998 GE Guidelines, and 219 had been approved. Of all courses that had been submitted for continuing certification 171 were certified for 4 years, 27 for 2 years and, 15 for less than 2 years. Coordinator Summary Forms are available for review in the Office of Undergraduate Studies.
B.5.3 Program Outcomes for MS in CMPE

B.5.3.1 Assessment Coverage

<table>
<thead>
<tr>
<th>Courses</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>CMPE 200</td>
<td>X</td>
</tr>
<tr>
<td>CMPE 220</td>
<td>X</td>
</tr>
<tr>
<td>CMPE 294</td>
<td></td>
</tr>
<tr>
<td>CMPE 295A, B</td>
<td>X</td>
</tr>
<tr>
<td>Student survey</td>
<td>X</td>
</tr>
<tr>
<td>Advisory council</td>
<td>X</td>
</tr>
<tr>
<td>Alumni survey</td>
<td>X</td>
</tr>
<tr>
<td>Employer survey</td>
<td>X</td>
</tr>
<tr>
<td>Overall Result</td>
<td>X</td>
</tr>
</tbody>
</table>

X: Assessed; U: Covered but not assessed

B.5.3.2 Course Assessment

**CMPE 200**

Course Learning Objectives are

1. Understanding how assembly language instructions map to hardware operations: datapath and control circuitry.
2. Understand the classic pipelined RISC architecture, including analysis of dependencies, stalls and hazards.
3. Understanding enhancements of the basic pipelined architecture such as superscalar, Very Long Instruction Word (VLIW), etc.

Each course learning objective is assessed by a set of learning performance indicators.

<table>
<thead>
<tr>
<th>Course Learning Objective</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>202.1</td>
<td>X</td>
</tr>
<tr>
<td>202.2</td>
<td>X</td>
</tr>
<tr>
<td>202.3</td>
<td>X</td>
</tr>
</tbody>
</table>

X: Associate

Each course learning objective is assessed by a set of learning performance indicators.

<table>
<thead>
<tr>
<th>Course Learning Objectives</th>
<th>Learning Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Midterm Exam II</td>
</tr>
<tr>
<td>200.1</td>
<td>Q5</td>
</tr>
<tr>
<td>200.2</td>
<td>Q5</td>
</tr>
<tr>
<td>200.3</td>
<td>Q6</td>
</tr>
</tbody>
</table>

C: Criteria Q: Question
The following table gives the number and percentage of the 17 passing students who achieved a score of 80% or more on each indicator.

A student’s final grade is based on following scheme:

- **Midterm Exam** 36.9% [03/14/06]
- **Final Exam** 42.1% [05/23/06]
- **Project** 21%
- **Homework** assigned but not graded

**Midterm Exam**
The first 5 lectures reviewed the required prerequisite material for the course (corresponding to CmpE140). Following this, the first midterm exam on 6 Mar., 2006, with 9 questions, tested student understanding of the prerequisite material. 16 of 53 students (30.2%) achieved a score of 70% or better.

A second midterm exam with 12 questions was conducted on 24 Apr., 2006. The three course learning objectives (220.1, 220.2 and 220.3) were covered by the exam questions. Two questions were selected to measure the three learning objectives. (Since learning objectives 1 and 2 are closely related, one question involves two learning objectives.

For each question, we used 80% of the score as a passing mark. The results are shown in the table above.

The assessment rules used are (for each exam question):

- 70% or greater of the students (who achieved the passing mark of the question): Take no action.
- 60-69% of the students: Evaluate the teaching material and clarify the specific points missed by some students.
- Below 60% of the students: Explain the teaching material again to the class for the areas which were not cleared to the students.

**Final Exam**
The final exam with 12 questions was conducted on 22 May, 2006. All course learning objectives were covered by the exam questions. Two questions were selected to measure the three learning objectives. (Since learning objectives 1 and 2 are closely related, one question involves two learning objectives.

For each question, we used **80%** of the score as a passing mark. The results are shown in the table above.

The assessment rules used are (for each exam question):

- 70% or greater of the students (who achieved the passing mark of the question): Take no action.
- 60-69% of the students: Evaluate the teaching material and clarify the specific points missed by some students.
- Below 60% of the students: Explain the teaching material again to the class for the areas which were not cleared to the students.

**Project**
The team oriented project had three checkpoints along the way for which the students were required to turn in status reports, preliminary designs, and the like. The project was worth about 20 percent of the course grade. The project work was due on May 16, 2006. The project involved developing a simulation of three different hardware architectures. A team consisted of 3-4 students.

The three stages of the project correspond to the three learning objectives. For each question, we used **80%** of the score as a passing mark. The results are shown in the table above.

The assessment rules used are:

- 70% or greater of the project teams (who achieved the passing mark of the question): Take no action in the following semester.
- 60-69% of the project teams: Evaluate the project requirements and clarify the specific areas missed by some students in the following semester.
Below 60% of the project teams: Explain how to approach the project again to the class, especially in the areas which were not cleared to the students, and provide additional guidance to individual students in the following semester.

Homework Assignments
Homework assignments were not used in assessment because there is no way to ascertain that students work independently.

For each learning performance indicator, the average value of assessment data contributes to one or more course learning objectives.

<table>
<thead>
<tr>
<th>Course Learning Objectives</th>
<th>Learning Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Midterm</td>
</tr>
<tr>
<td>200.1</td>
<td>9 (53.0%)</td>
</tr>
<tr>
<td>200.2</td>
<td>9 (53.0%)</td>
</tr>
<tr>
<td>200.3</td>
<td>3 (17.6%)</td>
</tr>
</tbody>
</table>

For each course learning objective, we apply equal weights to team project and final exam. 80% is used as the threshold of assessing whether an objective is “achieved” or “to be improved”.

<table>
<thead>
<tr>
<th>Course Learning Objectives</th>
<th>Assessment Data</th>
<th>Student Learning Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Midterm</td>
<td>Exam</td>
</tr>
<tr>
<td>200.1</td>
<td>53.0%</td>
<td>64.7%</td>
</tr>
<tr>
<td>200.2</td>
<td>53.0%</td>
<td>64.7%</td>
</tr>
<tr>
<td>200.3</td>
<td>17.6%</td>
<td>23.5%</td>
</tr>
</tbody>
</table>

A: Achieved, I: To be improved

Student learning capabilities of all course learning objectives have to be improved. Hence, CMPE 200 does not contribute to achieve program outcomes 1, 2, and 6.

**CMPE 220**

Course Learning Objectives are:

1. Be able to learn the concepts and methods in designing various types of system software. System software consists of software programs that support the operations of a computer. A variety of system software programs (listed in the course description) are to be covered in the course.
2. Be able to learn the relationships between machine architecture and system software.
3. Be able to learn practical hands-on experience in designing and implementing some selected types of system software in a course team oriented project.
4. Be able to learn software engineering concepts and related issues in designing and implementing software projects. The concepts are applied in a team oriented course project.

<table>
<thead>
<tr>
<th>Course Learning Objective</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>220.1</td>
<td>X</td>
</tr>
<tr>
<td>220.2</td>
<td>X</td>
</tr>
<tr>
<td>220.3</td>
<td>X</td>
</tr>
</tbody>
</table>
Course Learning Performance Indicators

<table>
<thead>
<tr>
<th>Course Learning Objectives</th>
<th>Learning Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Midterm Exam</td>
</tr>
<tr>
<td>220.1</td>
<td>Question 1.2</td>
</tr>
<tr>
<td>220.2</td>
<td>Question 1.2</td>
</tr>
<tr>
<td>220.3</td>
<td>Question 2.3</td>
</tr>
<tr>
<td>220.4</td>
<td>Question 2</td>
</tr>
</tbody>
</table>

Assessment is based on following grading scheme:

- Homework 10%
- Special Topic Report 15%
- Midterm 25% [03/14/06]
- Final Exam 30% [05/23/06]
- Project 20%

One midterm exam with 3 questions was conducted on 03/14/06 in the class. The three course learning objectives (220.1, 220.2 and 220.3) were covered by the exam questions. A total of 100 pts was the full score of the exam: Question 1 - 20 pts, Question 2 - 40 pts and Question 3 - 40 pts. For each question, we used 60% of the score as a passing mark. The passing marks were: Question 1 – 12 pts, Question 2 – 24 pts, and Question 3 – 24 pts.

The assessment rules used are (for each exam question):

- 70% or greater of the students (who achieved the passing mark of the question): Take no action.
- 60-69% of the students: Evaluate the teaching material and clarify the specific points missed by some students.
- Below 60% of the students: Explain the teaching material again to the class for the areas which were not cleared to the students.

The final exam with 4 questions was conducted on 05/23/06 in the class. All four course learning objectives (220.1, 220.2, 220.3 and 220.4) were covered by the exam questions. A total of 100 pts was the full score of the exam: Question 1 - 30 pts, Question 2 - 25 pts, Question 3 - 20 pts and Question 4 – 25 pts. For each question, we used 60% of the score as a passing mark. The passing marks were: Question 1 – 18 pts, Question 2 – 15 pts, Question 3 – 12 pts and Question 4 – 15 pts.

The assessment rules used are (for each exam question):

- 70% or greater of the students (who achieved the passing mark of the question): Take no action.
- 60-69% of the students: Evaluate the teaching material and clarify the specific points missed by some students.
- Below 60% of the students: Explain the teaching material again to the class for the areas which were not cleared to the students.
Assignments were together worth about 10 percent of the course grade. Late homework was accepted but was marked down 50%. The due date for the assignments was given during the class. There were six problems assigned to the students.

The assessing rule is:

- 80% or more of the students correctly answered all the six questions.

The special topic report assignment was optional. Each participating project team chose a special topic in the context of systems software and performed an in-depth study and investigation. The report (10-15 pages) includes analysis, findings, insights and suggestions of improvement to the problems/issues identified. The report was worth 15 percent of the course grade. The due date was May 24, 2006.

A list of areas for special topic reports was provided at the course web site. Each special topic team (1-2 persons) selected a specific topic in the area chosen and collected related information to explore potential problems/issues by February 28, 2006.

Special topic report was evaluated based on the following six criteria for the report coverage:

A. Topic introduction, related technology and work, and background concepts
B. Problem investigation
C. Problem solving approach
D. Experiments and analysis
E. Special design
F. Results, conclusions, demonstration and documentation

Criteria 1 and 2 together account for 30 pts, criteria 3 and 4 for 40 pts, and criteria 5 and 6 for 30 pts respectively. The passing mark for the special topic report is 80 pts.

The assessment rules used are:

- 70% or greater of the students (who achieved the passing mark of the question): Take no action in the following semester.
- 60-69% of the students: Evaluate the special topic report requirements and clarify the specific areas missed by some students in the following semester.
- Below 60% of the students: Explain how to approach the special topic report again to the class, especially in the areas which were not cleared to the students, and provide additional guidance to individual students in the following semester.

The team oriented project had frequent checkpoints along the way for which the students were required to turn in status reports, preliminary designs, and the like. The project was worth about 20 percent of the course grade. The project work was due on May 16, 2006. Project descriptions and requirements were provided at the course web site. A team consisted of 3-4 students. Each team was assigned a pre-determined project topic in system software based on the textbook. A list of detailed project descriptions and input/output requirements were provided at the course web site to the students.

Project results were assessed with project presentation, software demonstration and project documentation. All were evaluated on team basis. However, individual(s) who contributed more than others were recognized and credited with extra points. Each project was required to go through three test cases provided by the professor during the project demonstration. A team was asked either to modify its project input or to explain certain code.

A team was required to pass at least two test cases to declare the pass of the project demonstration.

Team projects were evaluated based on the following six criteria for the project coverage:

1. Project introduction and background
2. Architecture and design of the software
3. Algorithm and data structures used in the implementation
4. Design results (design analysis, flow charts and documentation)
5. Conclusions (summary and your insight gained from the work of project design and implementation)
6. Source code and implementation results (source code of the programs and execution results with various cases of input data)

Criteria 1 and 2 together account for 20 pts., criteria 3 and 4 for 30 pts., and criteria 5 and 6 for 50 pts, respectively. The passing mark for the project is 85 pts.

The assessment rules used are:

- 70% or greater of the project teams (who achieved the passing mark of the question): Take no action in the following semester.
- 60-69% of the project teams: Evaluate the special topic report requirements and clarify the specific areas missed by some students in the following semester.
- Below 60% of the project teams: Explain how to approach the special topic report again to the class, especially in the areas which were not cleared to the students, and provide additional guidance to individual students in the following semester.

**Project Schedule:**
There was a project presentation. No makeup presentation was given, unless the case was critical. For the exceptional cases, documented reasons (e.g. physician’s statement) were required.

- Project Milestone I     03/07/06
- Project Milestone II     04/18/06
- Final Project Review     05/09/06 & 05/16/06

The milestones were used to help the teams make progress and solve any problems.

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**CMPE 295A/B**

The Course Learning Objectives for CMPE 295A are
1. Ability to formulate and communicate a project topic under the guidance of an advisor.
2. Ability to communicate via a project report using documentation guidelines.
3. Ability to conduct research, analysis, design, implementation, verification, and other development tasks for a project.

The Course Learning Objectives for CMPE 295B are
1. Ability to finalize research, analysis, design, implementation, verification, and other development tasks for a project.
2. Ability to communicate via a project report and a project presentation.

<table>
<thead>
<tr>
<th>Course Learning Objective</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

The Course Learning Objectives for CMPE 295A/B are
1. Ability to formulate and communicate a project topic under the guidance of an advisor.
2. Ability to communicate via a project report using documentation guidelines.
3. Ability to conduct research, analysis, design, implementation, verification, and other development tasks for a project.

The Course Learning Objectives for CMPE 295B are
1. Ability to finalize research, analysis, design, implementation, verification, and other development tasks for a project.
2. Ability to communicate via a project report and a project presentation.
X: Assessed; U: Covered but not assessed

Course Learning Performance Indicators for CMPE 295A and CMPE 295B

<table>
<thead>
<tr>
<th>Course Learning Objectives</th>
<th>Learning Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>295A.1</td>
<td>Abstract assignment; first two chapters assignment grade</td>
</tr>
<tr>
<td>295A.2</td>
<td>Abstract assignment; first two chapters assignment grade</td>
</tr>
<tr>
<td>295A.3</td>
<td>Project Plan assignment grade; worksheet questions 1 - 4</td>
</tr>
<tr>
<td>295B.1</td>
<td>Worksheet questions 1 – 4</td>
</tr>
<tr>
<td>295B.2</td>
<td>Worksheet questions 5 – 6</td>
</tr>
</tbody>
</table>

Assessment is performed based on feedback from advisors. The feedback is communicated by filling out a worksheet that asks advisors to answer 6 questions related to student technical and communication capabilities. Advisors are also asked to rate the student's performance in each of the six questions. Students are rated individually even though they may be part of a team project.

B.5.3.3 Student Exit Survey

The Graduate Engineering Student Exit Survey consists of questions relating to the academic program, project/thesis experience, and their overall education and student life experiences at SJSU. Upon completion of their last course, CMPE 295B, students are asked to submit their evaluations. The result of the responses is an average of 4 on a scale of 1 to 5, where 5 is strong agree. This indicates that the Computer Engineering department is on-track in terms of educational planning for the students in the graduate program.

B.5.3.4 Advisory Council Input

B.5.3.4.1 Advisory Council Input Assessment Questions

The questions asked to be evaluated by the Department Advisory Council (DAC) are the Program Outcomes themselves. Thus, the Advisory Council survey questions are an equivalent 1:1 mapping relationship to the Program Outcomes.

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>Q#</th>
</tr>
</thead>
<tbody>
<tr>
<td>I  Be able to demonstrate an understanding of advanced knowledge of the practice of computer or software engineering, from vision to analysis, design, validation and deployment.</td>
<td>1</td>
</tr>
<tr>
<td>II Be able to tackle complex engineering problems and tasks, using contemporary engineering principles, methodologies and tools.</td>
<td>2</td>
</tr>
<tr>
<td>III Be able to demonstrate leadership and the ability to participate in teamwork in an environment with different disciplines of engineering, science and business.</td>
<td>3</td>
</tr>
<tr>
<td>IV Be aware of ethical, economic and environmental implications of their work, as appropriate.</td>
<td>4</td>
</tr>
<tr>
<td>V Be able to advance successfully in the engineering profession, and sustain a process of life-long learning in engineer or other professional areas.</td>
<td>5</td>
</tr>
</tbody>
</table>
VI  Be able to communicate effectively, in both oral and written forms.  

B. 5.3.4.2 Advisory Council Input Assessment Results
The Department Advisory Council (DAC) for the Computer Engineering program, consists of 3 members from the industry, whose responses are tallied below.

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>4.4</td>
</tr>
<tr>
<td>II</td>
<td>4.4</td>
</tr>
<tr>
<td>III</td>
<td>4.4</td>
</tr>
<tr>
<td>IV</td>
<td>3.2</td>
</tr>
<tr>
<td>V</td>
<td>4.3</td>
</tr>
<tr>
<td>VI</td>
<td>4.3</td>
</tr>
</tbody>
</table>

B.5.3.5 Alumni Survey

B.5.3.5.1 Alumni Survey Questions

<table>
<thead>
<tr>
<th>Q#</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Please list the job titles you have held since graduation.</td>
</tr>
<tr>
<td>2</td>
<td>How well has SJSU prepared you for the following engineering tasks:</td>
</tr>
<tr>
<td>2a</td>
<td>Requirements gathering</td>
</tr>
<tr>
<td>2b</td>
<td>Functional Specification Preparation</td>
</tr>
<tr>
<td>2c</td>
<td>Modeling</td>
</tr>
<tr>
<td>2d</td>
<td>Design/Development</td>
</tr>
<tr>
<td>2e</td>
<td>UI Mockup</td>
</tr>
<tr>
<td>2f</td>
<td>Implementation</td>
</tr>
<tr>
<td>2g</td>
<td>Quality Assurance</td>
</tr>
<tr>
<td>2h</td>
<td>Product Deployment</td>
</tr>
<tr>
<td>2i</td>
<td>Product Maintenance</td>
</tr>
<tr>
<td>2j</td>
<td>Documentation</td>
</tr>
<tr>
<td>2k</td>
<td>Customer Support</td>
</tr>
<tr>
<td>2l</td>
<td>Maintenance</td>
</tr>
<tr>
<td>3</td>
<td>Please list the type of projects, how long you were involved, role</td>
</tr>
<tr>
<td></td>
<td>and disciplines of your teammates (engineering, science, business, etc.).</td>
</tr>
<tr>
<td>4</td>
<td>Please name some tools, methodologies, or equipment you have used on a</td>
</tr>
<tr>
<td></td>
<td>regular basis professionally.</td>
</tr>
<tr>
<td>5</td>
<td>Did SJSU prepare you to be aware of:</td>
</tr>
<tr>
<td>5a</td>
<td>Ethical Issues</td>
</tr>
<tr>
<td>5b</td>
<td>Environmental Issues</td>
</tr>
</tbody>
</table>
B.5 Program Outcomes and Assessment

The mapping relationship between the alumni questions and the program outcomes are shown in the table below.

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>Q#</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>2</td>
</tr>
<tr>
<td>II</td>
<td>3</td>
</tr>
<tr>
<td>III</td>
<td>4</td>
</tr>
<tr>
<td>IV</td>
<td>5</td>
</tr>
<tr>
<td>V</td>
<td>6</td>
</tr>
<tr>
<td>VI</td>
<td>7</td>
</tr>
<tr>
<td>VII</td>
<td>8</td>
</tr>
</tbody>
</table>

**B.5.3.5.1 Alumni Survey Results**

There were a total of 31 computer engineering alumni who responded to our survey. The alumni information was retrieved from the Alumni Association office. The surveys were conducted online, where a link to the survey was sent either by email (when possible) or by snail mail.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Questions</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>How well has SJSU prepared you for the each of the following engineering tasks: from vision to analysis, design, validation and deployment?</td>
<td>4.19</td>
</tr>
<tr>
<td>II</td>
<td>Name some tools, methodologies, or equipment that you have used on a regular basis professionally.</td>
<td>100% Named appropriate tools</td>
</tr>
<tr>
<td>III</td>
<td>Please list the type of projects, how long you were involved in the project, the role in which you partook, and the disciplines of your teammates (engineering, science, business, etc.).</td>
<td>Average 2.59</td>
</tr>
<tr>
<td>IV</td>
<td>Did SJSU prepare you to be aware of: ethical, economical, and environmental issues?</td>
<td>3.51</td>
</tr>
<tr>
<td>V</td>
<td>Please list the job titles you have held since graduation.</td>
<td>100% Discipline-related</td>
</tr>
<tr>
<td></td>
<td>Life-long learning: courses, training, and degrees after graduation.</td>
<td>62.5% Training 4.17% Degree</td>
</tr>
<tr>
<td></td>
<td>List your most significant achievements since you graduated.</td>
<td>57.14% Career advancement 28.57% Innovative achievement 7.14% Awards</td>
</tr>
</tbody>
</table>
How many professional presentations have you given the last 12 months?  Average 6.48 presentations

How many reports and publications have you written? Please provide some example titles/topics.  Average 2.47 reports

Note: The average projects, presentations, and reports/publications are not calculated based on a scale of 5, but rather the calculated average number of activity per responses.

Some comments provided by the alumni:

“Computer engineering courses at SJSU are very practical and help us to jump in to entry level jobs. Also graduate student class projects opened insights to industry trends and common technology in depth.”

“The MS program at SJSU gave me an excellent foundation for a career in the software industry. We had very knowledgeable and dedicated instructors…”

B.5.3.6 Employer Survey

B.5.3.6.1 Employer Survey Questions

<table>
<thead>
<tr>
<th>Q#</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>How many SJSU graduate students have you supervised?</td>
</tr>
<tr>
<td>2</td>
<td>How well has SJSU prepared you for the each of the following engineering tasks:</td>
</tr>
<tr>
<td>2a</td>
<td>Requirements gathering</td>
</tr>
<tr>
<td>2b</td>
<td>Functional Specification Preparation</td>
</tr>
<tr>
<td>2c</td>
<td>Modeling</td>
</tr>
<tr>
<td>2d</td>
<td>Design/Development</td>
</tr>
<tr>
<td>2e</td>
<td>UI Mockup</td>
</tr>
<tr>
<td>2f</td>
<td>Implementation</td>
</tr>
<tr>
<td>2g</td>
<td>Quality Assurance</td>
</tr>
<tr>
<td>2h</td>
<td>Product Deployment</td>
</tr>
<tr>
<td>2i</td>
<td>Product Maintenance</td>
</tr>
<tr>
<td>2j</td>
<td>Documentation</td>
</tr>
<tr>
<td>2k</td>
<td>Customer Support</td>
</tr>
<tr>
<td>2l</td>
<td>Maintenance</td>
</tr>
<tr>
<td>3</td>
<td>How well do your SJSU graduates perform as:</td>
</tr>
<tr>
<td>3a</td>
<td>Project Participants</td>
</tr>
<tr>
<td>3b</td>
<td>Project Leaders</td>
</tr>
<tr>
<td>3c</td>
<td>Project Managers</td>
</tr>
<tr>
<td>4</td>
<td>Do SJSU graduates use engineering:</td>
</tr>
<tr>
<td>4a</td>
<td>Principles</td>
</tr>
<tr>
<td>4b</td>
<td>Methodologies</td>
</tr>
<tr>
<td>4c</td>
<td>Tools</td>
</tr>
<tr>
<td>5</td>
<td>Did SJSU prepare your graduates to be aware of:</td>
</tr>
<tr>
<td>5a</td>
<td>Ethical Issues</td>
</tr>
<tr>
<td>5b</td>
<td>Environmental Issues</td>
</tr>
<tr>
<td>5c</td>
<td>Economical Issues</td>
</tr>
<tr>
<td>6</td>
<td>How well do you think SJSU graduates are motivated to pursue life-long learning in engineering?</td>
</tr>
<tr>
<td>7</td>
<td>Relative to other graduates, how well do you think SJSU graduates advance in their career?</td>
</tr>
<tr>
<td>8</td>
<td>How do you rate SJSU graduates in their ability to communicate in verbal and written forms?</td>
</tr>
<tr>
<td>9</td>
<td>Additional Comments</td>
</tr>
</tbody>
</table>

The mapping relationship between the employer questions and the program outcomes are shown in the table below.
B. PROGRAM PLANNING REVIEW REPORT

I
Be able to demonstrate an understanding of advanced knowledge of the practice of computer or software engineering, from vision to analysis, design, validation and deployment.

II
Be able to tackle complex engineering problems and tasks, using contemporary engineering principles, methodologies and tools.

III
Be able to demonstrate leadership and the ability to participate in teamwork in an environment with different disciplines of engineering, science and business.

IV
Be aware of ethical, economic and environmental implications of their work, as appropriate.

V
Be able to advance successfully in the engineering profession, and sustain a process of life-long learning in engineer or other professional areas.

VI
Be able to communicate effectively, in both oral and written forms.

B.5.3.6.2 Employer Survey Results

The 5 computer engineering responding employers included: Cisco Systems, Yahoo, eBay, Intevac, and AMCC. The following are the results from their survey responses, which was also conducted online.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>How well has SJSU prepared you for the each of the following engineering tasks: from vision to analysis, design, validation and deployment?</td>
<td>3.97</td>
</tr>
<tr>
<td>II</td>
<td>Do SJSU graduates use engineering principles, methodologies, and tools?</td>
<td>4.4</td>
</tr>
<tr>
<td>III</td>
<td>How well do SJSU graduates perform as project participants, project leaders, and project managers?</td>
<td>4.33</td>
</tr>
<tr>
<td>IV</td>
<td>Are your SJSU graduates aware of ethical, environmental, and economical issues?</td>
<td>4.55</td>
</tr>
<tr>
<td>V</td>
<td>How well do you think SJSU graduates are motivated to pursue life-long learning in engineering</td>
<td>100% Yes</td>
</tr>
<tr>
<td></td>
<td>Relative to other graduates, how well do you think SJSU graduates advance in their career?</td>
<td>4.50</td>
</tr>
<tr>
<td>VI</td>
<td>How do you rate SJSU graduates in their ability to communicate in verbal and written forms?</td>
<td>4.30</td>
</tr>
</tbody>
</table>

Some comments provided by employers about SJSU graduates:

“In the top tier of all hires”

“The graduates usually are very motivated to learn on what is needed on the job.”

“SJSU gave a good foundation to work from.”
B.5.4 Program Outcomes and Assessment for BS in SE

B.5.4.1 Program Outcomes

The BS in Software Engineering program is designed to produce computer engineering graduates who have attained:

(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.

It will be noted that these outcomes are the same as those defined in ABET Criterion 3. The faculty considered the ABET list in detail, and decided that the list as provided and described was sufficiently comprehensive and clearly stated to meet the needs of the Computer Engineering program. Table B.4.5.1.3.1 shows how the computer engineering program outcomes support the program educational objectives.

Figure B.5.4.2.1 provides a visualization of our overall assessment process with those items contributing to the assessment cycle of the program outcomes highlighted.

B.5.4.2 Program Outcomes Assessment

By following BS in CMPE program, the assessment process is described in Figure B.5.4.2.1. The PEOs and program outcomes act as the basis upon which the curriculum is built and sustained. Using the concepts of continuous improvement (which is itself taught in several courses), the curriculum is scrutinized at both the content level and the course delivery level to assure quality in the program. Several procedural mechanisms are in place to assure that the program outcomes are monitored effectively.

Figure B.4.5.1.1.3 provides a visualization of our overall assessment process, including program-, and course-level assessment and enhancement cycles (highlighted in Figure B.5.4.2.1).
Figure B.5.4.2.1 The Program Outcome Assessment Cycle

Establish and enhance Program Educational Objectives

Establish and enhance Program Learning Objectives

Establish and enhance Program Outcomes

Assess the PEO Achievements

Assess the Course Learning Objectives Achievements

Assess the Program Outcomes Achievements

Outcome Report

Program Report

Course Journal

Enhance course

Enhance curriculum

Student course performance

Student course feedback

Senior/Junior feedback

Student exit focus groups and survey

Alumni feedback

Employer feedback

Advisory Council feedback

Program delivery

Institutional mission and goals

ABET criteria
Through this process, we assess and assure that computer engineering graduates have achieved the program outcomes. Program educational objectives are achieved primarily through the curriculum (technical and general education) by the design and control of the contributions made by individual courses as well as their (“vertical”) integration into a cumulative growth for the student. The following discussion describes the assessment plan in detail, including assessment of the curriculum (technical and general education), and its integration into assessment of achievement of program outcomes.

B.5.4.2.1 Assessment Process

The assessment cycle of course learning objectives is depicted in Figure B.5.4.2.1.1. A pilot evaluation was conducted for testing the assessment system of the program outcomes by using a limited sampling of courses, student work and constituent data. The initial implementation and testing of the assessment process identified several important lessons that led to system revisions/clarifications, and the start of an educational process for the faculty:

4. A clearly understood relationship and flow must occur from course learning objectives through program outcomes to PEOs. All course syllabuses now provide a correlation of student learning goals through course learning objectives and a connection to the program outcomes.

5. Department faculty must have a common understanding of what constitutes well-conceived and well-written objectives at the course and program levels. A great deal of faculty discussion and consideration was given to the connections between course contents and learning objectives, and of distinguishing among the department, program and course levels.

6. Outcomes performance criteria must be accompanied with metrics of achievement. After several department meetings, a two-category (achieved and to-be-improved) and three-level achievement (basic, intermediate, and advanced) metrics was adopted.

The process itself of designing, implementing and testing the assessment system has led to assessing the need for the faculty developing common concepts and terminology, adopting a constituent-driven evaluation process, and focusing on student learning (and its measurement). The goal is to complete an evaluation of all program outcomes every year. An outcome champion will be assigned and responsible for organizing the collection of materials needed for the evaluation. This involves giving guidance to the faculty about what is needed to complete the assessment. A stratified random sampling technique is used to ensure that materials from the entire spectrum of students are used in the assessment. All members of the team assess each sample.
Figure B.5.4.2.1.1 The Course Learning Objective Assessment Cycle
B.5.4.3 Assessment of the Technical Curriculum by Program Faculty

The BS in Software Engineering program outcome assessment and enhancement process through course learning objective assessment is visualized in Figure B.5.4.2.1.1 with those items contributing to the course learning objective assessment are highlighted. The primary supporting materials for the process consist of course journals, student work collected from the various courses, and constituency assessment materials. Particular emphasis is placed on the integrative experience of the student who is longitudinally tracked from entry through employment.

B.5.4.3.1 Course Journal

A course journal is constructed, for all required courses and select elective course, to serve two purposes:

- **Course Improvement**: By documenting a set of requirements for course content encompassed in course learning objectives, evaluation indicators for these objectives encompassed in learning performance indicators, and achievement levels for each, it promotes consistency, quality and dependability for the course, regardless of who is teaching it. Course assessment results for the achievement of course learning objectives are used to identify where and how improvements can be made to enhance student learning.

- **Evaluation of Outcome Support**: By documenting a set of requirements for assessable components, and contributions to program outcomes and combined with student work and feedback collected from the course, it is used as a source for assessing student achievement with regard to program outcomes.

The course journal characterizes the contributions the course is intended to make to student learning and progression towards the program outcomes. To assess the extent to which the course delivery succeeds, student work is collected from a sampling of students of all passing grade levels. Assessment of the student work together with the course journal is used to evaluate and improve the course and also to evaluate and improve the course’s contribution to Program outcomes as it is integrated into the curriculum. A course journal consists of four sections: course description, course modifications, course assessment, and assessment data.

B.5.4.3.1.1 Course Description

The course description includes the syllabus, an explanation of the significance of the course learning objectives and a course assessment matrix.

- **Syllabus**: describes the CLOs, the course content, the course conduct.
- **Significance of Course Learning Objectives**: includes a table to describe the relationships of CLOs to POs. The relationships are represented in content capability levels. There are three categories of content capability levels:
  - Level 1 – Basic level: knowledge, comprehension
  - Level 2 – Intermediate level: application, analysis
  - Level 3 – Advanced level: synthesis, evaluation
- **Course Assessment Matrix**: describes the CLOs, Learning Performance Indicators (LPIs), assessment methods, prerequisites, and content levels. LPIs are indicators associated with a particular CLO that can be evaluated using designated assessment methods to indicate student performance. All LPIs for a particular CLO are used to make the assessment of achievement for that CLO. The assessment methods are categorized as follows:
  - E – Exam and test
  - F – Stakeholder feedback
  - H – Homework assignment
  - J – Project
  - L – Laboratory assignment
  - P – Presentation
  - R – Report
  - S – Survey
X – Exit survey
O – Others

B.5.4.3.2 Course Modifications
Based on the actions recommended as a result of previous course assessments, the modifications of a course are summarized in the following categories.

- Changes to course learning objectives
- Changes to course content
- Changes to laboratory
- Changes to textbook
- Changes to prerequisites
- Others

B.5.4.3.3 Course Assessment
After each semester, a summary of content levels and assessment capability levels for each course learning objective is summarized in a table. Furthermore the following areas related to each courses are assessed:

- Assessment of student learning capability levels: each “to be improved” learning performance indicator consists of a description of data sources, analysis statements, and action items with individual tracking identifications
- Assessment of student performance: includes a summary, a comparison with overall departmental student grades, a comparison with previous student grades, an analysis of the trend, and a list of actions with tracking identifications.
- Assessment of student feedback: includes a summary, a comparison with overall departmental student survey, a comparison with previous student course feedback of each course learning objectives, an analysis of each to be improved course learning objective, and a list of actions with tracking identifications.
- Assessment of other feedback
- Summary of actions: includes an action id, description, implementation, and status of each action related to the course.

B.5.4.3.4 Assessment Data
The data pertinent to the assessment of each course is included in this section. The data is presented in the following sequence.

- Exams and tests
- Homework assignments
- Laboratory assignments
- Presentations
- Reports
- Projects
- Student feedback
- Stakeholder feedback
- Others

B.5.4.3.2 Outcome Report
The department faculty members have identified the courses chosen as primary supporting courses for each program outcome. Faculty members have also subscribed as the outcome champions for each program outcome. Each outcome champion uses course journals and additional materials to assess the extent of the achievement of the specific program outcome. The process is organized and described in the outcome report developed by individual outcome champion. Each outcome report contains materi-
als of various program outcome assessment methods (surveys of various constituents, student coursework results) and materials showing how individual courses link to the program outcome.

Each outcome champion develops the program outcome context from the program’s perspective. Each outcome champion also develops a road map that describes the expected “vertical” integration, i.e., freshman through senior year, of course contributions supporting achievement of a program outcome’s performance criteria. The outcome champion assesses achievement of the program outcome by evaluating constituent assessment results, the collected student work, and the course journal materials in light of the road map and specified performance criteria. Having determined the extent to which the program outcome was achieved by the cumulative curriculum, the outcome champion evaluates and recommends changes for the purpose of increasing achievement, which are discussed and approved or revised by the whole faculty. The department implements the approved changes to achieve program (and course) enhancement. The program outcome report includes the road map and provides an historical summary of overall assessment results, evaluation results and enhancement plans and their implementation.

Based on the course journals and in conjunction with additional assessment data, a report is developed for each of the eleven program outcomes. Each outcome report consists of following sections:

B.5.4.3.2.1 Operational Definition of the Outcome

It describes the measurement criteria of student’s capability level in order to fulfill the requirements of the outcome.

B.5.4.3.2.2 Curriculum Progression towards the Outcome

It is a road map that describes the expected “vertical” integration of the program outcome from multiple course categories. It includes the following sections:

• Program summary
• Preparation courses
• Engineering core courses
• Degree required courses

B.5.4.3.2.3 Course to Program Outcome Assessment

It is a matrix to describe the course type, assessment methods, content level, and assessed capability level of each course applicable to the outcome.

<table>
<thead>
<tr>
<th>Course type</th>
<th>Content level</th>
<th>Assessed capability level</th>
</tr>
</thead>
<tbody>
<tr>
<td>P – Preparation</td>
<td>1 – Knowledge, comprehension, or basic level</td>
<td>A – Adequate (above or meets expectation)</td>
</tr>
<tr>
<td>C – Engineering core</td>
<td>2 – Application, analysis, or intermediate level</td>
<td>I – To be improved (below expectation)</td>
</tr>
<tr>
<td>R – Degree required</td>
<td>3 – Synthesis, evaluation, or advanced level</td>
<td>U – Covered but not assessed</td>
</tr>
<tr>
<td>E – Degree elective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G – General education</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B.5.4.3.2.4 Outcome Assessment and Recommended Actions

An assessment summary of the program is given with data sources, analysis, and action items. Detailed assessment and recommended actions are described in the following course blocks:

• Preparation courses
• Engineering core courses
• Required major courses

B.5.4.3.2.5 Basis for Assessment

This section provides data extracted from:
• Course journals
• Alumni feedback
• Employer feedback
• Department Advisory Committee report
• Minutes of meetings with course coordinators
• Others

B.5.4.3.3 Status of the Assessment Process
The assessment process will start in Spring 2007.

B.5.4.4 Assessment of the Technical Curriculum by Industry Representatives
Some senior projects will be sponsored and reviewed by industry partners. Volunteers from the engineering industry will be invited to perform course assessments. Each industrial representative will be engaged in the following tasks:
• Reviews the design project statement for content and realistic constraints,
• Attends design labs to assist students with designs,
• Attends presentations of final designs and other deliverables (prototypes) and evaluate student groups,
• Provides feedback to the faculty members for improvement.

B.5.4.5 Laboratory Assessment
Teams that include representatives from local industry will be invited to provide a laboratory assessment (both physical space and course support). The teams consist of members of the Department Advisory Council and additional volunteers. The process will consist of a visit to the laboratory at which the team is introduced to the activities, the equipment, and plans for future upgrades. Final recommendations will be made regarding the quality of the experiments, the quality of the documentation and the quality of the equipment. The results of the assessment will be used to evaluate curriculum content as well as assist in setting priorities for laboratory development.

B.5.4.6 Assessment of General Education
B.5.4.6.1 General Education Contributions to Engineering Outcomes
*The General Education Program Guidelines* define the overall goals of General Education (GE) program, which are in line with the SJSU Mission and goals. The GE program goals are:
• To develop analytical skills and reasoning powers.
• To increase the ability to communicate ideas effectively both in speaking and in writing.
• To enhance the ability to live and work intelligently, responsibly, and cooperatively in a multicultural society and an increasingly interdependent world.
• To provide a fundamental understanding of science and the natural world.
• To further knowledge and appreciation of the arts and letters.
• To promote citizenship through knowledge of the forces that shape the individual and modern society.
• To develop abilities to address complex issues and problems using disciplined analytic skills and creative techniques.

The GE goals overlap significantly with the ABET outcomes, in particular with the following outcomes:
(d) an ability to function on multi-disciplinary teams
(f) an understanding of professional and ethical responsibilities
(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

The GE program consists of the Core and Advanced course. Core GE courses target such skills as oral communication, written communication, critical thinking, and math concepts. Advanced GE course
have as prerequisites completion of Core GE and a junior-level Writing Skills Test. The four Advanced GE Areas are:

- Area Z. Written Communication II (100W, known as Engineering Reports)
- Area R. Earth and Environment
- Area S. Self, Society and Equality in the United States
- Area V. Culture, Civilization and Global Understanding

### B.5.4.6.2 General Goals of Advanced GE

Within the Advanced GE areas, students in all majors are called upon to demonstrate certain skills and competencies judged to be important to an educated person in today’s society. All courses in these four areas must build upon the skills and knowledge base of the Core GE. The four Advanced GE areas complement education in the individual majors by assuring:

- **Advanced Writing.** The 100W courses require a minimum of 8,000 words, and each of the other three Advanced Areas a minimum of 3,000 words. In both instances, “..practice and feedback..” are required; thus simply turning in an end-of-semester term paper does not satisfy the GE requirement.

- **Interdisciplinary Perspectives.** All Advanced GE courses must consider issues from different academic disciplines.

- **Application of basic skills.** All Advanced GE courses demand that students use core GE skills (reading, writing, speaking, critical thinking, research, and math).

- **Active participation.** All Advanced GE courses require active student participation.

- **Research.** All Advanced GE courses require students to utilize library research (broadly interpreted to include contemporary electronic information sources). Class study materials must include primary sources.

Table B.5.4.6.2.1 summarizes the contributions of the GE program to outcomes d, f, g, h, i and j. All GE areas include area goals and specific student learning objectives. Every GE course that is certified must provide evidence that students demonstrate achievement of the learning objectives as discussed in the section on GE certification and assessment.

| Table B.5.4.6.2.1: Contributions of GE Areas to ABET Outcomes |
|-------------------------------|-----------------------------|
| **Outcome** | **GE Area** |
| (d) an ability to function on multidisciplinary teams. | D1, D2, D3 – Social Sciences  
R – Earth and Environment  
S – Self, Society & Equality  
V – Culture, Civilization and Global Understanding  
Z – Written Communication |
| (f) an understanding of professional and ethical responsibility. | A1 – Oral Communication  
A2 – Written Communication 1A  
E – Human Understanding and Development  
S – Self, Society & Equality |
| (g) an ability to communicate effectively | A1 – Oral Communication  
A2 – Written Communication 1A  
C3 – Written Communication 1B  
Pass the writing skills test  
S – Self, Society & Equality  
V – Culture, Civilization and Global Understanding  
Z – Written Communication |
| (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context | B1, B2 – Science  
C1 – Arts  
C2 – Letters  
D1, D2, D3 – Social Sciences  
R – Earth and Environment  
S – Self, Society & Equality  
V – Culture, Civilization and Global Understanding |
B.5.4.6.3 Course Certification and Assessment

GE courses go through a detailed planning and review process. Prior to the establishment of a new course, the faculty must submit a proposal that includes learning objectives, a syllabus, and an assessment plan. Assessment of GE student learning outcomes is based on course-specific assignments and activities rather than standardized tests. The plans typically specify which activities, assignments, and exams will be used to assess each of the General Education objectives. Occasionally a plan also includes pre-and post-tests or surveys. All Core GE courses are reviewed by area-specific General Education Advisory Panels (GEAPs), each of which is made up of six or seven faculty members from several colleges. Advanced GE courses are reviewed by the ten-member Board of General Studies (BOGS). The recommendations of the GEAPs are advisory and all final decisions are made by the BOGS. The GEAPs and the BOGS incorporate more than 80 faculty members in the review and assessment process.

Following review, the BOGS gives an initial certification of up to two years for approved courses. Then, based on the approved assessment plans, faculty collect data on student performance related to general education learning objectives. The course coordinator submits a Coordinator Summary Form that summarizes assessment methods, student performance related to each learning objective, and course modifications based on the assessment aimed at improving student learning for all sections of the course that are taught. After review of the coordinator report, the BOGS certifies courses for up to four more years depending on the results of the two-year assessment. Certified courses are reviewed every two to four years (depending on the level of certification). When members of the BOGS identify concerns about how courses are meeting student learning objectives, a process is in place where course coordinators meet with BOGS members or with a faculty-in-residence at the Center for Faculty Development to help identify effective improvements to the course.

As of February 2004, 260 courses had been submitted for initial certification under the 1998 GE Guidelines, and 219 had been approved. Of all courses that had been submitted for continuing certification 171 were certified for 4 years, 27 for 2 years and, 15 for less than 2 years. Coordinator Summary Forms are available for review in the Office of Undergraduate Studies.
B.5.5 Program Outcomes for MS in SE

B.5.5.1 Assessment Coverage

<table>
<thead>
<tr>
<th>Course</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I   II  III IV  V VI</td>
</tr>
<tr>
<td>CMPE 202</td>
<td>X   X</td>
</tr>
<tr>
<td>CMPE 203</td>
<td>X   X</td>
</tr>
<tr>
<td>CMPE 294</td>
<td></td>
</tr>
<tr>
<td>CMPE 295A, B</td>
<td>X   X</td>
</tr>
<tr>
<td>Student survey</td>
<td>X   X</td>
</tr>
<tr>
<td>Advisory council</td>
<td>X   X</td>
</tr>
<tr>
<td>Alumni survey</td>
<td>X   X</td>
</tr>
<tr>
<td>Employer survey</td>
<td>X   X</td>
</tr>
<tr>
<td>Overall Result</td>
<td>X   X</td>
</tr>
</tbody>
</table>

X: Assessed, U: Covered but not assessed

B.5.5.2 Course Assessment

CMPE 202

Course Learning Objectives are

1. Be able to understand the integrated approach to software systems development.
2. Be able to perform software development tasks from a system’s point of view.
3. Be able to generate modeling artifacts for different phases of software development cycle.

Each course learning objective is associated with one or more program outcomes.

<table>
<thead>
<tr>
<th>Course Learning Objective</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I   II  III IV  V VI</td>
</tr>
<tr>
<td>202.1</td>
<td>X   X</td>
</tr>
<tr>
<td>202.2</td>
<td>X   X</td>
</tr>
<tr>
<td>202.3</td>
<td>X   X</td>
</tr>
</tbody>
</table>

X: Associate

Course Learning Performance Indicators are

Each course learning objective is assessed by a set of learning performance indicators.

<table>
<thead>
<tr>
<th>Course Learning Objective</th>
<th>Learning Performance Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Team Project</td>
</tr>
<tr>
<td>202.1</td>
<td>C1</td>
</tr>
<tr>
<td>202.2</td>
<td>C2</td>
</tr>
<tr>
<td>202.3</td>
<td>C3</td>
</tr>
</tbody>
</table>

C: Criteria Q: Question,

The learning capability of each student is assessed based on team projects and comprehensive final exam.
Teams were formed during the second week of the semester. The scope of the team project was to analyze and design a web-enabled system to provide Customer Relationship Management services.

The project is based on the Unified Process. It consists of 4 major phases: requirement, analysis, design, and construction. During the semester, the instructor reviewed with each team member multiple times on the deliverables of each phase of the project.

At the end of the semester, each team delivered a comprehensive project report. The project report includes 5 sections: system conception, domain analysis, application analysis, system design, and object design.

For each project team, the instructor assessed students’ learning capability individually and jointly. Based on course learning objectives, the assessment was based on following three criteria:

1. The capability of understanding the integrated approach to software systems development.
2. The capability of performing software development tasks from a system’s point of view.
3. The capability of generating modeling artifacts for different phases of software development cycle.

On May 18, 2006 a comprehensive final exam was conducted. It composed of 5 questions.

1. Question 1 assessed students’ capability of understanding the integrated approach to software systems development.
2. Question 2 assessed students’ capability of performing software development tasks from a system’s point of view. Students were assigned to analyze system requirements and construct Java, C++, or C# codes segment with design patterns.
3. Question 3 assessed students’ capability of generating modeling artifacts for design and construction phases.
4. Question 4 assessed students’ capability of generating modeling artifacts for the analysis phase.
5. Question 5 assessed students’ capability of generating modeling artifacts for the requirement phase.

CMPE 203

Course Learning Objectives are to have the ability to:
1. Understand the issues, processes, responsibilities and tasks in software engineering project management.
2. Understand the different organizational approaches to software engineering project management.
3. Understand techniques involved in the successful leadership of software development project teams.
4. Apply engineering discipline to software development management
5. Function in a leadership role for software development teams.
6. Communicate effectively during a software engineering project.
7. Effectively gather and document project requirements.
8. Discern the most effective process to use for a given project.
9. Effectively estimate, schedule, and plan work for a project team.
10. Apply critical thinking to the solution of software development problems and to effectively communicate the results of that thinking.

<table>
<thead>
<tr>
<th>Course Learning Objective</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>203.1</td>
<td>X</td>
</tr>
<tr>
<td>203.2</td>
<td>X</td>
</tr>
<tr>
<td>203.3</td>
<td>X</td>
</tr>
<tr>
<td>Course Learning Objectives</td>
<td>Learning Performance Indicators</td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td></td>
<td>Midterm Exam</td>
</tr>
<tr>
<td></td>
<td>Sec 1</td>
</tr>
<tr>
<td>203.1</td>
<td>Q1, 2, 3</td>
</tr>
<tr>
<td>203.2</td>
<td>Q1, 2, 3</td>
</tr>
<tr>
<td>203.3</td>
<td>Q1, 2, 4, 5</td>
</tr>
<tr>
<td>203.4</td>
<td>Q2</td>
</tr>
<tr>
<td>203.5</td>
<td>Q1</td>
</tr>
<tr>
<td>203.6</td>
<td>Q1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>203.7</td>
<td>Q2</td>
</tr>
<tr>
<td>203.8</td>
<td>Q1, 3</td>
</tr>
<tr>
<td>203.9</td>
<td>Q4</td>
</tr>
<tr>
<td>203.10</td>
<td>Q3, 5</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

On 3/14/06 and 3/15/06 a midterm exam was conducted for students in sections 1 and 2. Each midterm consisted of five questions each focusing on specific course objectives. In total there were 108 students. Scores are totaled for each question. Any question in which 90% or greater was achieved resulted in no change in teaching. Questions receiving scores between 80 and 89% are watched and the material evaluated for specific points missed. Any question receiving below 80% on the midterm had the material covered for a second time following Spring Break.

Finals for sections 1 and 2 were given 5/22/06 and 5/23/06. Individual questions were again scored. Any question receiving less than 85% will have the topic’s presentation material revised for the following semester.

Team projects are evaluated both on the basis of the teams in class presentation and student reports/journal. The in class presentation demonstrates the results of the project. The student report/journal documents what the student was able to observe during the semesters team exercises and project. This focuses on what the student learns about leadership and team dynamics. The results feed directly into guidance given students at the beginning of the following semester. Any specific issues will be highlighted to students in the following semester. For example in earlier semesters teams had difficulty picking topics and getting started before the very end of the semester. The result has been to change the format so teams are assigned topics in the second week of the semester. Additionally teams are required to make a formal status report of their progress prior to the midterm.
Research papers are evaluated on two primary criteria. The first is the overall presentation of the topic. Are there too many grammatical errors, are there smooth transitions from one section to the next. The second criterion is a demonstration by the student that they have understood the topic and have reached a conclusion on how to apply the topic that they researched. This is evaluated on how well the student supports the conclusion they reached. Feedback from each semester in used in providing guidance to students in the following semester.

**CMPE 295A/B**

The Course Learning Objectives for CMPE 295A are:
1. Ability to formulate and communicate a project topic under the guidance of an advisor.
2. Ability to communicate via a project report using documentation guidelines.
3. Ability to conduct research, analysis, design, implementation, verification, and other development tasks for a project.

The Course Learning Objectives for CMPE 295B are:
1. Ability to finalize research, analysis, design, implementation, verification, and other development tasks for a project.
2. Ability to communicate via a project report and a project presentation.

<table>
<thead>
<tr>
<th>Course Learning Objective</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>295A.1</td>
<td>X</td>
</tr>
<tr>
<td>295A.2</td>
<td></td>
</tr>
<tr>
<td>295A.3</td>
<td>X</td>
</tr>
<tr>
<td>295B.1</td>
<td></td>
</tr>
<tr>
<td>295B.2</td>
<td></td>
</tr>
</tbody>
</table>

X: Associate

**Course Learning Performance Indicators for CMPE 295A and CMPE 295B**

<table>
<thead>
<tr>
<th>Course Learning Objectives</th>
<th>Learning Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>295A.1</td>
<td>Abstract assignment; first two chapters assignment grade</td>
</tr>
<tr>
<td>295A.2</td>
<td>Abstract assignment; first two chapters assignment grade</td>
</tr>
<tr>
<td>295A.3</td>
<td>Project Plan assignment grade; worksheet questions 1 - 4</td>
</tr>
<tr>
<td>295B.1</td>
<td>Worksheet questions 1 – 4</td>
</tr>
<tr>
<td>295B.2</td>
<td>Worksheet questions 5 – 6</td>
</tr>
</tbody>
</table>

Assessment is performed based on feedback from advisors. The feedback is communicated by filling out a worksheet that asks advisors to answer 6 questions related to student technical and communication capabilities. Advisors are also asked to rate the students performance in each of the six questions. Students are rated individually even though they may be part of a team project.

**B.5.5.3 Student Exit Survey**

The Graduate Engineering Student Exit Survey consists of questions relating to the academic program, project/thesis experience, and their overall education and student life experiences at SJSU. Upon comple-
tion of their last course, CMPE 295B, students are asked to submit their evaluations. The result of the responses is an average of 4.3 on a scale of 1 to 5, where 5 is strong agree. This indicates that the Computer Engineering department is on-track in terms of educational planning for the students in the graduate program.

**B.5.5.4 Advisory Council Input**

The questions asked to be evaluated by the department Advisory Council are the Program Outcomes themselves. Thus, the Advisory Council survey questions are an equivalent 1:1 mapping relationship to the Program Outcomes.

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Q#</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1</td>
</tr>
<tr>
<td>II</td>
<td>2</td>
</tr>
<tr>
<td>III</td>
<td>3</td>
</tr>
<tr>
<td>IV</td>
<td>4</td>
</tr>
<tr>
<td>V</td>
<td>5</td>
</tr>
<tr>
<td>VI</td>
<td>6</td>
</tr>
</tbody>
</table>

The questions asked to be evaluated by the department Advisory Council are the Program Outcomes themselves. Thus, the Advisory Council survey questions are an equivalent 1:1 mapping relationship to the Program Outcomes.

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>4.5</td>
</tr>
<tr>
<td>II</td>
<td>4.4</td>
</tr>
<tr>
<td>III</td>
<td>4.7</td>
</tr>
<tr>
<td>IV</td>
<td>3.7</td>
</tr>
<tr>
<td>V</td>
<td>4.5</td>
</tr>
<tr>
<td>VI</td>
<td>4.4</td>
</tr>
</tbody>
</table>
B.5.5.5 Alumni Survey

B.5.5.5.1 Alumni Survey Questions

<table>
<thead>
<tr>
<th>Q#</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Please list the job titles you have held since graduation.</td>
</tr>
<tr>
<td>2</td>
<td>How well has SJSU prepared you for the following engineering tasks:</td>
</tr>
<tr>
<td>2a</td>
<td>Requirements gathering</td>
</tr>
<tr>
<td>2b</td>
<td>Functional Specification Preparation</td>
</tr>
<tr>
<td>2c</td>
<td>Modeling</td>
</tr>
<tr>
<td>2d</td>
<td>Design/Development</td>
</tr>
<tr>
<td>2e</td>
<td>UI Mockup</td>
</tr>
<tr>
<td>2f</td>
<td>Implementation</td>
</tr>
<tr>
<td>2g</td>
<td>Quality Assurance</td>
</tr>
<tr>
<td>2h</td>
<td>Product Deployment</td>
</tr>
<tr>
<td>2i</td>
<td>Product Maintenance</td>
</tr>
<tr>
<td>2j</td>
<td>Documentation</td>
</tr>
<tr>
<td>2k</td>
<td>Customer Support</td>
</tr>
<tr>
<td>2l</td>
<td>Maintenance</td>
</tr>
<tr>
<td>3</td>
<td>Please list the type of projects, how long you were involved in the project, the role in which you partook, and the disciplines of your teammates (engineering, science, business, etc.).</td>
</tr>
<tr>
<td>4</td>
<td>Please name some tools, methodologies, or equipment that you have used on a regular basis professionally.</td>
</tr>
<tr>
<td>5</td>
<td>Did SJSU prepare you to be aware of:</td>
</tr>
<tr>
<td>5a</td>
<td>Ethical Issues</td>
</tr>
<tr>
<td>5b</td>
<td>Environmental Issues</td>
</tr>
<tr>
<td>5c</td>
<td>Economical Issues</td>
</tr>
<tr>
<td>6</td>
<td>Life-long learning</td>
</tr>
<tr>
<td>6a</td>
<td>How many training or university courses have you attended since graduation?</td>
</tr>
<tr>
<td>6b</td>
<td>Please list some of the names or topics.</td>
</tr>
<tr>
<td>6c</td>
<td>Did you receive any degrees after graduation from SJSU?</td>
</tr>
<tr>
<td>7</td>
<td>List your most significant achievements since you graduated.</td>
</tr>
<tr>
<td>8</td>
<td>How many professional presentations have you given the last 12 months? Please give some example titles/topics.</td>
</tr>
<tr>
<td>9</td>
<td>How many reports and publications have you written? Please provide some example titles/topics.</td>
</tr>
<tr>
<td>10</td>
<td>Additional Comments</td>
</tr>
</tbody>
</table>

The mapping relationship between the alumni questions and the program outcomes are shown in the table below.

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>Q#</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>2</td>
</tr>
<tr>
<td>II</td>
<td>3</td>
</tr>
<tr>
<td>III</td>
<td>4</td>
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<tr>
<td>IV</td>
<td>5</td>
</tr>
<tr>
<td>V</td>
<td>6</td>
</tr>
<tr>
<td>VI</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>Q#</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>2</td>
</tr>
<tr>
<td>II</td>
<td>3</td>
</tr>
<tr>
<td>III</td>
<td>4</td>
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<tr>
<td>IV</td>
<td>5</td>
</tr>
<tr>
<td>V</td>
<td>6</td>
</tr>
<tr>
<td>VI</td>
<td>7</td>
</tr>
</tbody>
</table>

Program Outcomes

I. Be able to demonstrate an understanding of advanced knowledge of the practice of computer or software engineering, from vision to analysis, design, validation and deployment.

II. Be able to tackle complex engineering problems and tasks, using contemporary engineering principles, methodologies and tools.

III. Be able to demonstrate leadership and the ability to participate in teamwork in an environment with different disciplines of engineering, science and business.

IV. Be aware of ethical, economic and environmental implications of their work, as appropriate.

V. Be able to advance successfully in the engineering profession, and sustain a process of life-long learning in engineer or other professional areas.

VI. Be able to communicate effectively, in both oral and written forms.
B.5.5.5.2 Alumni Survey Responses
Software engineering alumni surveys were conducted identically to that of the computer engineering alumni surveys, which was online. From the 39 respondents, the following table demonstrates their aggregate responses.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Questions</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>How well has SJSU prepared you for the each of the following engineering</td>
<td>4.07</td>
</tr>
<tr>
<td></td>
<td>tasks: from vision to analysis, design, validation and deployment?</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Please name some tools, methodologies, or equipment that you have used on</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>a regular basis professionally.</td>
<td>Named</td>
</tr>
<tr>
<td>III</td>
<td>Please list the type of projects, how long you were involved in the project,</td>
<td>Average</td>
</tr>
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<td></td>
<td>the role in which you partook, and the disciplines of your teammates (engineering,</td>
<td>2.32</td>
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<tr>
<td></td>
<td>science, business, etc.).</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Did SJSU prepare you to be aware of: ethical, economical, and environmental</td>
<td>3.62</td>
</tr>
<tr>
<td></td>
<td>issues?</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Please list the job titles you have held since graduation.</td>
<td>99.97%</td>
</tr>
<tr>
<td></td>
<td>Life-long learning: courses, training, and degrees after graduation.</td>
<td>30.77%</td>
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<tr>
<td></td>
<td>List your most significant achievements since you graduated.</td>
<td>54.55%</td>
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<td>18.18%</td>
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<td></td>
<td>9.09%</td>
</tr>
<tr>
<td>VI</td>
<td>How many professional presentations have you given the last 12 months?</td>
<td>Average</td>
</tr>
<tr>
<td></td>
<td>How many reports and publications have you written? Please provide some</td>
<td>2.48</td>
</tr>
<tr>
<td></td>
<td>example titles/topics.</td>
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<td></td>
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<td>0.62</td>
</tr>
</tbody>
</table>

Note: The average projects, presentations, and reports/publications are not calculated based on a scale of 5, but rather the calculated average number of activity per responses.

Some comments provided by the alumni:

“SJSU MSSE is a great program, which improved my career. Not only that it improved my confidence, my communication skills, my presentation skills, and also my professional network of people...”

“...I very much appreciate the topics available, the valuable contacts I made, and good preparation on practical software development...”

B.5.5.6 Employer Survey

B.5.5.6.1 Employer Survey Questions

<table>
<thead>
<tr>
<th>Q#</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>How many SJSU graduate students have you supervised?</td>
</tr>
<tr>
<td>2a</td>
<td>Requirements gathering</td>
</tr>
<tr>
<td>2b</td>
<td>Functional Specification Preparation</td>
</tr>
<tr>
<td>2c</td>
<td>Modeling</td>
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<tr>
<td>2d</td>
<td>Design/Development</td>
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<tr>
<td>2e</td>
<td>UI Mockup</td>
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<tr>
<td>2f</td>
<td>Implementation</td>
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<tr>
<td>2g</td>
<td>Quality Assurance</td>
</tr>
</tbody>
</table>
The mapping relationship between the employer questions and the program outcomes are shown in the table below.

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Q#</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>2</td>
</tr>
<tr>
<td>II</td>
<td>4</td>
</tr>
<tr>
<td>III</td>
<td>3</td>
</tr>
<tr>
<td>IV</td>
<td>5</td>
</tr>
<tr>
<td>V</td>
<td>6</td>
</tr>
<tr>
<td>VI</td>
<td>8</td>
</tr>
</tbody>
</table>

**B.5.5.6.2 Employer Survey Responses**

The 6 software engineering employers who responded to our surveys were from the following companies: EMC, Bling Software, EDS, Yahoo, RingCube, and eBay.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>How well has SJSU prepared you for the each of the following engineering tasks: from vision to analysis, design, validation and deployment?</td>
<td>3.71</td>
</tr>
<tr>
<td>II</td>
<td>Do SJSU graduates use engineering principles, methodologies, and tools?</td>
<td>3.23</td>
</tr>
<tr>
<td>III</td>
<td>How well do SJSU graduates perform as project participants, project leaders, and project managers?</td>
<td>4.00</td>
</tr>
<tr>
<td>IV</td>
<td>Are your SJSU graduates aware of ethical, environmental, and economical issues?</td>
<td>3.75</td>
</tr>
<tr>
<td></td>
<td>How well do you think SJSU graduates are motivated to pursue life-long learning in engineering</td>
<td>100% Yes</td>
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<td>---</td>
<td>-------------------------------------------------------------------------------------------------</td>
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<tr>
<td></td>
<td>Relative to other graduates, how well do you think SJSU graduates advance in their career?</td>
<td>4.50</td>
</tr>
<tr>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>How do you rate SJSU graduates in their ability to communicate in verbal and written forms?</td>
<td>4.17</td>
</tr>
</tbody>
</table>
B.6 Data Analysis and Recommendations for Improvement

B.6.1 BS in CMPE

Outcomes are assessed annually, and the primary assessment instruments are the course assessment journal, and student feedback through surveys, focus groups and exit evaluations. The faculty meet at the beginning of every semester for a full day’s retreat. At least one retreat per year has assessment and curriculum improvement as its main agenda item. The assessment cycle is depicted in Figure B.5.2.2.1. The components that contribute to the program outcome assessment include the following:

- Outcome reports
- Junior / senior survey
- Student exit survey through a nationally normed study (EBI)
- Senior projects
- Graduating student focus groups
- Employer feedback

B.6.1.1 Outcome reports

Table B.6.1.1.1 summarizes the result of course based assessments of outcomes from the academic year 2004/2005 based on input from the course journals. (In order to keep the assessment process reasonable with respect to faculty and staff workload the program does not assess all the courses where a particular outcome is being touched upon by the curriculum. A representative sample is identified, with the focus being on courses towards the end of the curriculum, where the expectations regarding the capabilities of the graduating student are should most likely have been satisfied.)

For each outcome, the course achievement levels are categorized into three levels:

- Level 1: Basic level; knowledge, comprehension
- Level 2: Intermediate level; application, analysis
- Level 3: Advanced level; synthesis, evaluation.

For each course being assessed, each Course Learning Objective is mapped to the appropriate outcome for which it serves as an indicator, and the measures by which an outcome level is deemed to be achieved.

For each outcome, the achievement indicators are then aggregated into an overall indicator for the particular course. This provides a fairly fine-grained view of a course’s contribution to any particular outcome. It also provides insight into cases where the program satisfies a particular outcome, but where there may be a need to focus on some specific part of the outcome in order to achieve an overall satisfactory state.

Based on the course assessments alone, all the eleven program outcomes were assessed as achieved at levels 3.
Table B.6.1.1 Summary of Outcome Assessment
(assessed courses identified by an underscore)

<table>
<thead>
<tr>
<th>Outcome /Course</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
<th>i</th>
<th>j</th>
<th>k</th>
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</thead>
<tbody>
<tr>
<td>GE Area A: Skills</td>
<td>1</td>
<td>1</td>
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<tr>
<td>GE Area C: Humanities &amp; Arts</td>
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<td>GE Area D: Social Science</td>
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<td>GE Area E: Human Understanding &amp; Dev</td>
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<td>MATH 42</td>
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<td>GE Area B: Science *</td>
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<td>CMPE 110</td>
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<td>CMPE 125</td>
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<td>CMPE 127</td>
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<td>MATH 133A</td>
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<td>MATH 129A or MATH 138 or 143C</td>
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<td>GE Area R: Earth &amp; Environment *</td>
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<td>GE Area Z: Written Communication *</td>
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<td>CMPE 131</td>
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<td>GE Area V: Culture, Civilization &amp; Global</td>
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<td>GE Area S: Self, Society &amp; Equality</td>
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<td>CMPE 195B</td>
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</tbody>
</table>

* GE Area B covered within Math, Phys & Chem required courses
GE Area R & Z covered within Engr 100W required course
B.6.1.2 Course Based Assessment – Student Work and Student Feedback

The primary basis for the internal assessment is the student work generated in response to student assignments. The course journal characterizes the contributions the course is intended to make to student learning and progression towards the program outcomes. To assess the extent to which the course delivery succeeds student work is collected from a sampling of students of all passing grade levels, along with student feedback on their confidence in their performance. Figure B.6.1.2.1 depicts the flow of information from student work and feedback, collected and documented in the course journal, to the assessment of the course learning objectives and program outcomes. Course learning objectives are evaluated based on one to many learning performance indicators specifically defined for a given objective. Assessment of the course learning objectives are used to evaluate and improve the course and also to evaluate and improve the course’s contribution to program outcomes as it is integrated into the curriculum.

![Course-based Program Outcome Assessment Flow](image)

As an example, consider the course CMPE 110 (Introduction to Digital Electronics). It supports outcomes (a), (b), (c), (g) and (k) (some more substantially than others, of course). The map from learning objectives to outcomes identify the support flow, and the learning performance indicators identifies how the learning objectives are assessed.

![Sample student course survey result](image)

In addition to student work, the students are surveyed at the end of the course to gauge their perception of their abilities in some of course learning objective areas. The results can identify areas where the students are likely to be weak, as well as areas where the student perception is significantly at odds with the evidence provided through the student work.
We generally consider results above 0.70 as satisfactory. For CMPE 110 fall 2004 the result is shown in Figure B.6.1.2.2

**B.6.1.3 Junior and senior surveys**

In addition to outcome assessments based on specific courses and the student work completed in the courses, the program also surveys students of the same or similar class rank: Juniors, seniors and graduating students.

The assessment instruments are surveys administered to the juniors and seniors, focus groups with the graduating students, and a normalized, national exit survey for students about to graduate.

The surveys for juniors and seniors request their evaluation of (1) the importance of each of the program outcomes to them, and (2) the extent to which they have achieved a complete mastery of the specific outcome.

**Figure B.6.1.3.1 Junior and Senior Surveys – Score Progression**

![Junior / Senior Feedback Results](image)

The survey instruments are *not* intended to assess the students’ achievements per se, but serve as indicators regarding whether the various aspects of professional engineering have been internalized by the students, and also to identify areas where there might be significant divergence between students’ self-assessment and the assessment of the faculty and other stakeholders.

Comparing results for juniors and seniors also provides insight into the changes in the students’ perception as they move through the last year of study, and from this progression one may find indicators of the students’ learning achievements.

For the 2004-05 academic year the survey yielded the results listed in Figure B.6.1.3.1 (responses below 70 would be the ones to watch out for):

There is a marked improvement in the students’ perception of their capabilities in outcomes c and d from the juniors to the seniors. This is to be expected, as the themes of design within constraints (c) and teamwork (d) are ever-present during their last year of study, and in particular in their work on the capstone senior projects.
The scores on \( h \) (broad education) and \( j \) (contemporary issues) warrant note, and we refer to the more detailed evaluation in B.6.1.8.

**B.6.1.4 Nationally Normed Exit Survey (EBI)**

A new assessment instrument was introduced spring 2005. The program participated for the first time in the national EBI Engineering Student Study. The study captures student perceptions and provides valuable insight into some of the more subjective aspects of the students’ learning achievements. Since the study provides comparisons with the results from other, similar institutions of higher learning some weight can be given to the results, and they can provide a good starting point for further consideration of aspects of the program, its content, delivery and supporting infrastructure. 57 students responded to the survey – essentially the whole graduating class.

The peer institutions for the spring 2005 study were the 2004 results from CSU Los Angeles, CSU Northridge, Kettering University, University of Arkansas, University of Texas at Dallas and University of Toledo.

The survey addresses the program outcomes as well as other aspects of the students’ education experience (e.g., perceived quality of computing resources). In order to evaluate the students’ perception with respect to the program outcomes, the questions relevant to a particular outcome were grouped together and the results compared with those of students from the peer institutions.

The responses from the SJSU Computer Engineering students exceeded the average from the peer institutions for all program outcomes. If we consider a difference of 0.5 or more as being significant, then the SJSU Computer Engineering students scored comparatively well on outcomes \( (a), (b), (c), (d), (g), (j) \) and \( (k) \) (See Figure B.6.1.4.1, where a positive result indicates a score above that of the peers’ average).

If we consider the set of all the questions in the study and how the SJSU respondents compared with the average of the peers (provided in Figure B.6.1.4.2, where a positive result indicates a score above that of the peers’ average) is slightly less uniformly rosy.

The students of the program score well on most of the questions. The most significant negative divergence was on questions 23 and 26. #23 asks for their level of satisfaction with academic advising by non-faculty, and #26 asks for their level of satisfaction with remote access opportunities to the engineering school's computer network.

Figure B.6.1.4.1 Difference between SJSU Computer Engineering scores and those of peers for program outcomes \( a-k \)

(Positive numbers indicate that SJSU exceeds the average peer).
The low score on #23 strengthens our perception that improved advising with regard to the procedural and policy oriented aspects of the student experience is called for. The college is already acting upon this and is establishing a student advising center.

The low score on #26 was not quite so anticipated. However, on the basis of this survey and other indicators from the student learning experience the department is now investing in infrastructure to increase the remote access availability of the department’s computing resources.

It is encouraging to see that the students’ perception of the program having provided them with an enhanced ability to function on multidisciplinary teams (#40), to understand ethical responsibilities (#42) and understand contemporary issues (#55), exceeds that of the peer institutions.

With regard to the capstone course experience, the students also indicated that the course addressed environmental, health and safety and social issues (#60, #64, #65) and that it was truly a capstone experience building on previous coursework (#57).

The importance of the laboratories is reflected in the strong score on the degree that laboratory facilities established an atmosphere conducive to learning (#67) and the degree that laboratory facilities fostered student/faculty interaction (#70) and the related questions (#13, #14).

### B.6.1.5 Senior Projects

Faculty members also use the capstone course project results to assess the extent to which the curriculum is being used by students as they address the requirements of their senior project. Examples of student capstone course projects are included in the examples of student work for CMPE 195A and B.

### B.6.1.6 Graduating Students Focus Groups

The focus groups are taken through a semi-structured conversation regarding the students’ learning experience, centered on the students experience through their career with the program. An objective is to contrast the instructors’ expectations for the program with the students’ understanding of what they
have achieved. In a focus group the information is likely to be of higher quality than what can be extracted from a survey, and the format allows a drilling down into details where warranted – to assess the students’ real achievements besides their own perceptions of their achievements. In particular the focus groups allow for an examination of where the students feel that time is inefficiently spent, and cases where the stated learning objectives are less than fully achieved. The surveys and focus groups have not caused significant changes to the program during the period under review, but they have provided sufficient information for the faculty to consider re-evaluating the role of the engineering common core.

B.6.1.7 Employer Survey
A survey of employers of our graduates indicates an overall agreement that our graduates (as they experience them) are doing well on each of the outcomes (see Table B.4.5.1.4.2.1, summarized here).

<table>
<thead>
<tr>
<th>Program outcomes</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
<th>i</th>
<th>j</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>3.3</td>
<td>3.3</td>
<td>2.8</td>
<td>3.3</td>
<td>3.3</td>
<td>2.9</td>
<td>2.9</td>
<td>2.8</td>
<td>2.8</td>
<td>2.6</td>
<td>2.6</td>
</tr>
</tbody>
</table>

We will refer back to these results when we evaluate each outcome.

B.6.1.8 Assessment Results
The material collected from these feedback processes provides a basis for assessing our current state of affairs with respect to the graduates of the program having achieved each of the program outcomes. All the outcomes were achieved, but there are still suggestions arising from the assessment as to areas where further improvement may be obtained. The following is a summary of outcome reports and the findings regarding their achievement. For each outcome, we
- Provide a narrative demonstrating the student’s progression through the curriculum with respect to the given outcome.
- list the key courses for the outcome,
- give a general overview of their content as it pertains to the outcome.
- Provide a table which specifically links the contribution towards the outcome with course learning objectives.
- provide examples of student assignments that address the outcome.
- provide our summary evaluation regarding whether the outcome has been achieved, and
- indicate where there may be room for further improvements (even in cases of having achieved the outcome).

B.6.1.8.1 Program Outcome a
“To demonstrate that graduates have an ability to apply knowledge of mathematics, science and engineering”.
A computer engineering graduate must be able to apply knowledge of mathematics, science, and engineering. SJSU computer engineering students complete their courses in physics, chemistry, and mathematics before pursuing their upper-division work in computer engineering. The major courses build upon their knowledge of mathematics, physics and chemistry. In the upper-division program they add more advanced mathematics courses and continue to develop their engineering knowledge by completing a sequence of courses in which math and science knowledge is repeatedly applied. The progression through the courses contributing to outcome a is

**Preparation Courses**
- Prepare students to engage in the engineering studies towards the outcome
  - MATH 30, 31, 32, 42 (The calculus sequence, discrete mathematics)
  - PHYS 70, 71, or PHYS 50, 51, 52 (mechanics, electricity and magnetism)
  - CHEM 1A (general chemistry)
Engineering Core Courses

- CMPE 46 & CMPE 101 - Introduction to the fundamental skills and tools to identify, formulate, and solve engineering problems with C++. In particular: Touches abstraction and basic algorithm analysis.
- ENGR 10 - Students work as a team to exercise (among other skills) the application of knowledge of mathematics and engineering to problem solving techniques, and get introduced to some basic concepts of sound engineering practices.
- EE 97, EE 98, EE 101 - Provide basic techniques and circuit analysis. Applies mathematics to the analysis of circuits (e.g., power calculations, the use of calculus in circuit analysis).
- ME 109 or MATE 153 - Provide students with thermal and material knowledge where they apply mathematics to address thermodynamics (ME 109) or physics to semiconductor processes (MATE 153).

Degree Required Courses

- MATH 133A, and one of 129A or 138 or 143C (diff. eq., linear algebra and others)
- CMPE 110, CMPE 124, CMPE 125 – Apply basic knowledge of mathematics and engineering and learn techniques and tools for analyzing and solving digital and analog circuit problems. E.g., uses differential equations, Boolean algebra, finite state machines,
- CMPE 102 – Provide basic knowledge in programming, abstraction techniques and use of programming tools. Apply basic knowledge of mathematics and engineering in solving programming problems. E.g., works with number systems, Boolean algebras, finite arithmetic, software/hardware interplay and tradeoffs.
- CMPE 126 – Provide basic knowledge to analyze problems and design applications for algorithms and data structures. Apply basic knowledge of mathematics in solving programming problems. E.g., applies recurrence relations to algorithmic complexity reasoning, makes use of recursive definitions, hashing functions. Teaches functional and class abstraction.
- CMPE 131 – Provide basic knowledge in software engineering, software engineering techniques and applied tools in solving software engineering problems. Apply basic knowledge of mathematics in solving software engineering problems. E.g., basic combinatoric reasoning is applied to evaluating system complexity. Introduce engineering process planning, requirement and design tradeoffs.
- CMPE 127, CMPE 140 – Provide capability to understand and design digital and computer hardware systems. Apply fundamental knowledge of mathematics and engineering to analyze problems and develop applications for microprocessors, computer architecture and computer systems. E.g., computer arithmetic, architecture tradeoff considerations, performance analysis.
- CMPE 130, CMPE 142, CMPE 152 – Provide capability to understand file processing, operating systems and compilers. Apply fundamental knowledge of mathematics and engineering to analyze problems and develop applications for file processing, operating systems, and compilers. E.g., applies statistical and probabilistic reasoning to reliability and performance questions, uses formal languages and automata in translation systems, understand and can evaluate encoding schemes.
- ISE 130 – Provide statistical knowledge and skills, statistical techniques, processes, and tools to formulate and analyze engineering problems, and analyze, interpreting data obtained for experiments. Apply fundamental knowledge of mathematics in formulating and analyzing engineering problems in statistical terms. Students learn how to write and document statistical formulas, analysis results, and reports for engineering problems.
- CMPE 195A & B – Engage students applying basic knowledge of mathematics and engineering using variety of techniques and modern engineering tools in identifying, formulating, and solving real-life problems. Engage students in designing and conducting computer engineering related experiments and in analyzing data in the life-cycle through design projects synthesis, evaluation, implementation and initial testing. Engage students in the practices that cover the entire process of problem formation, design, implementation and validation at both com-
ponent and system level, involving hardware and software. Apply the mathematics and science appropriate to the project at hand.

**Major courses: Specific contributions to the outcome**

<table>
<thead>
<tr>
<th>Course</th>
<th>Contributions to the outcome arising from the course learning objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>At the end of the course the student will be able…</strong></td>
<td></td>
</tr>
<tr>
<td>CMPE 110</td>
<td>To perform time-domain and frequency domain analysis of passive circuits. Analyzing transmission line effects in integrated circuit interconnects.</td>
</tr>
<tr>
<td></td>
<td>– Time-domain and frequency domain analysis of passive elements namely RC, RL and RLC circuits, Laplace transforms, transfer functions, impulse and step responses.</td>
</tr>
<tr>
<td></td>
<td>– The basics of semiconductors, NMOS and PMOS transistor conduction mechanisms</td>
</tr>
<tr>
<td>CMPE 124</td>
<td>To demonstrate a practical knowledge of switching theory, mixed logic, and ASM.</td>
</tr>
<tr>
<td></td>
<td>– Define and to explain Boolean algebra, mixed logic concepts, state machine algorithms.</td>
</tr>
<tr>
<td>CMPE 125</td>
<td>To design and verify digital system building blocks.</td>
</tr>
<tr>
<td></td>
<td>– To design and verify basic to mediate-level combinational, sequential and storage building blocks.</td>
</tr>
<tr>
<td></td>
<td>– To discuss I-V characteristics of NMOS and PMOS transistors.</td>
</tr>
<tr>
<td></td>
<td>– To design and verify finite state machines</td>
</tr>
<tr>
<td>CMPE 126</td>
<td>To be proficient in the use of standard algorithmic techniques including recursion, hashing, searching and sorting.</td>
</tr>
<tr>
<td></td>
<td>– To apply basic concepts of recursion both as used in mathematical recurrence relations and in algorithm design.</td>
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<tr>
<td></td>
<td>– To apply recursion to reasoning about algorithms for searching, sorting, and handling of trees.</td>
</tr>
<tr>
<td></td>
<td>– To discuss different schemes for hashing and techniques for dealing with collisions.</td>
</tr>
<tr>
<td>CMPE 127</td>
<td>To formulate and solve engineering design problems through experiments and implementation of microprocessor systems.</td>
</tr>
<tr>
<td></td>
<td>– Be able to understand and analyze system architecture, CPU organization and its basic operating principles.</td>
</tr>
<tr>
<td></td>
<td>– Be able to generate formal technical specifications.</td>
</tr>
<tr>
<td>CMPE 130</td>
<td>To analyze and calculate the performance of a system storing data in files.</td>
</tr>
<tr>
<td></td>
<td>– Be able to perform a comparative analysis of commercially available disk drives.</td>
</tr>
<tr>
<td></td>
<td>– Be able to discuss data encoding schemes for magnetic media.</td>
</tr>
<tr>
<td>CMPE 131</td>
<td>To plan and conduct a software engineering project.</td>
</tr>
<tr>
<td></td>
<td>– Be able to analyze and design software systems and generate software specifications.</td>
</tr>
<tr>
<td></td>
<td>– Be able to analyze system complexity using basic combinatoric reasoning.</td>
</tr>
<tr>
<td>CMPE 140</td>
<td>To discuss pipeline structures and pipeline timing problems in complex digital systems.</td>
</tr>
<tr>
<td>CMPE 142</td>
<td>To discuss the concepts and principles underlying the structures and designs of computer operating systems.</td>
</tr>
<tr>
<td></td>
<td>– To evaluate the relative merits of paging strategies.</td>
</tr>
<tr>
<td></td>
<td>– To evaluate the interaction and pitfalls of concurrency</td>
</tr>
<tr>
<td>CMPE 152</td>
<td>To achieve working skills in the theory and application of finite state machines, recursive descent, production rules, parsing, and language semantics.</td>
</tr>
<tr>
<td></td>
<td>– To be able to apply finite state machines in the definition of software</td>
</tr>
<tr>
<td></td>
<td>– To be able to define and read formal language grammars</td>
</tr>
<tr>
<td></td>
<td>– To be able to create appropriate recursive definitions for language grammars and their analysis.</td>
</tr>
<tr>
<td>CMPE 195A&amp; B</td>
<td>To conduct and manage a computer hardware/software project using basic project planning and management techniques.</td>
</tr>
<tr>
<td></td>
<td>– To be able to estimate probabilities in risk planning, and to discuss their significance.</td>
</tr>
<tr>
<td></td>
<td>– To be able to apply the appropriate mathematics and science to the planning and execution</td>
</tr>
</tbody>
</table>
Examples of assignments related to the outcome

The following are examples of exam questions, lab assignments and/or documentation deliverables at the different content levels that students must complete and that indicate their progression towards achievement of program outcome a. These examples target a student’s ability to apply mathematics, science or engineering to a problem.

CMPE 110 – In an examination question, students were asked to determine and plot the output voltage of a passive network as a function of time for a step input (in a form of a constant current source) using time-domain analysis. This requires solving a first order constant coefficient differential equation with initial conditions.

ISE 130 – In an examination question, students were asked to demonstrate their ability to apply statistics to determine the confidence level for an operating systems response time given the mean response time of sampling measurements and characteristics. The following is a write-up of the questions:

An operating system for a personal computer has been studied extensively, and it is know that the standard deviation of the response time following a particular command is \( \sigma = 8 \) milliseconds, and that the response time is normally distributed. A new version of the operating system is installed, and a sample of 25 measurements of the response time has mean response time of 30 milliseconds. Construct a 95% two-sided confidence level of the \( \mu \).

CMPE 130 – In an examination questions, students were asked to demonstrate their ability to apply the Poisson function to compute the following items for a set of records in a randomly hashed files: packing density, number of addresses with no records, and expected overflow. The following is the write-up of the question:

Suppose the 30,000 addresses are allocated to hold 70,000 records in a randomly hashed file, and that each address can hold 4 records. Using the Poisson function (listed in exam) compute the following: (a) packing density, (b) number of addresses with no records assigned to them by the hashing function, and (c) expected percentage of overflow records.

Conclusion

The understanding and application of mathematics and science are at the foundation of a computer engineer’s conceptual world. The students are iteratively taken through a series of math and science courses, and are repeatedly required to apply their understanding to domain specific engineering tasks. The external feedback (e.g., the employer survey rates the alumni at 3.3 with respect to this outcome), the student confidence level (significantly above that our the average of the peer institutions, and showing an increase across the last senior year) seems to confirm that our assessment that outcome a is well supported by the curriculum is valid.

B.6.1.8.2 Program Outcome b

“An ability to design and conduct experiments, as well as to analyze and interpret data”.

A computer engineering graduate must be able to

- design objective experiments in the computer engineering area to understand and be able to practice the required steps to demonstrate a concept/theory, an algorithm, or a procedure/method.
- have sufficient knowledge and skills to conduct experiments in an correct manner.
- objectively analyze data collected from experiments so that major interested data attributes can be extracted and processed.
- understand the meaning of the results generated from data analysis, and interpret them in an objective and realistic manner.

Our curriculum is designed to enable the graduate to gain the above capabilities through both hardware and software laboratory/project components. Early in the program, students conduct experiments in their science courses (PHYS 70, 71, or PHYS 50, 51, 52, and CHEM 1A). In their sophomore year, students take an introductory programming course (CMPE 46) and an introductory electri-
cal engineering laboratory course (EE 97). In CMPE 46, students learn how to use an integrated development environment to write and test simple software programs. In EE 97, they learn how to use basic laboratory instruments and build simple circuits.

In the upper-division program, students learn to conduct more complicated experiments using a variety of lab instruments and computer tools. The scope of their laboratory assignments progresses from device-level to system-level. Their ability to design and conduct experiments, as well as to analyze and interpret data grows with the scope of the laboratory assignments. In addition, students learn how to design experiments and analyze their results statistically by taking an engineering statistics class (ISE 130).

The progression through the course contribution to outcome b is

**Preparation Courses**
- PHYS 70, 71, or PHYS 50, 51, 52 (mechanics, electricity and magnetism)
- CHEM 1A (general chemistry)

**Engineering Core Courses**
- ENGR 10 – Students work as teams to apply knowledge of mathematics and engineering and practice problem solving techniques. Students use MATLAB and spreadsheets to identify, formulate, and solve engineering problems in supervised labs.
- EE 97 – Provide basic techniques and teach students to solve basic hardware problems and conduct experiments in a supervised lab.

**Degree Required Courses**
- CMPE 110, CMPE 124 – Apply basic knowledge of digital and circuits problems in supervised labs.
- CMPE 126 – Engage students in homework projects to analyze programming problems as well as design and test software applications that use standard data structures and algorithms.
- CMPE 125, CMPE 127 – Provide capability to understand and design digital and computer hardware component and systems. This includes implementing component and system level hardware and functional verification tests for microprocessors and computer systems.
- CMPE 130 – Provide capability to understand file processing. Apply fundamental knowledge of mathematics and engineering to develop applications for file processing. Work on project assignments on file processing programs and analyze their performance.
- ISE 130 – Provide statistical knowledge and skills, statistical techniques, processes, and tools to formulate and analyze engineering problems, and analyze and interpret data obtained for experiments.
- CMPE 140 – Provide capability to use modern engineering tools such as NCVerilog when verifying a RISC CPU.
- CMPE 195A & B – Engage students applying basic knowledge of mathematics and engineering using variety of techniques and modern engineering tools in identifying, formulating, and solving real-life problems. Engage students in designing and conducting computer engineering related experiments and in analyzing data with the life-cycle through design projects synthesis and evaluation. Provide capability to design and conduct quality assurance experiments, as well as to analyze and interpret the results of such experiments

**Major courses: Specific contributions to the outcome**

<table>
<thead>
<tr>
<th>Course</th>
<th>Contributions to the outcome arising from the course learning objectives</th>
</tr>
</thead>
</table>
| ENGR 010 | To conduct basic experiments and data analysis with engineering methods and computer tool.  
- Engage in lab projects with MATLAB |
<p>| EE 097  | To conduct experiments with fundamental electrical circuits |</p>
<table>
<thead>
<tr>
<th>Course</th>
<th>Objectives</th>
</tr>
</thead>
</table>
| CMPE 110 | To design and analyze transmission line effects in integrated circuit interconnects.  
|          | To design and analyze fundamental and complex transistor-level CMOS gates according to a specific design point: performance, area, and power.  
|          | To design complex gates and flip-flops with BiCMOS pass-gate logic family. |
| CMPE 124 | To design simple digital gates with TTL logic devices.                      |
| CMPE 125 | To perform hands-on design, verification and testing tasks on FPGAs          
|          | - Engage in lab projects with Verilog hardware description language (HDL), industry-standard electronic design automation (EDA) tools and prototyping equipment. |
| CMPE 126 | To design and debug fundamental software applications with standard abstract data types and data structures, including stacks, queues, and linked lists, trees, and graphs.  
|          | - Engage in project assignments with Visual C++                             
|          | To design and debug simple software applications with standard algorithmic techniques including recursion, hashing, searching, and sorting; To analyze the functional and performance characteristics of these techniques. |
| CMPE 127 | To design I/O interface and analyze the functional characteristics of the bus interface.  
|          | - Engage in lab projects based with 8255 (programmable peripheral processor) and 8259 (programmable interrupt controller) |
| ISE 130  | To analyze and interpret data with statistical methods, such as confidence intervals, hypothesis testing, and ANOVA. |
| CMPE 130 | To analyze and calculate the performance of a system sorting data in files.  
|          | To analyze and compare the performance of fundamental techniques for data storage and retrieval  
|          | - Engage in project assignments on I/O buffering, sequential access, indexing, B-trees, B+ trees, hashing, extendible hashing and co-sequential processing in a Unix environment. |
| CMPE 131 | To design and conduct object-oriented analysis and design experiments using UML, as well as to analyze and evaluate their models.  
|          | - Engage in lab projects with IBM Rational Rose                             |
| CMPE 140 | To design and verify a basic RISC CPU with modern engineering tools         
|          | - Engage in lab projects with NCVerilog in Cadence design environment.      |
| CMPE 195A&B | To analyze, design, and implement a computer hardware/software component/system based on the given requirements.  
|           | To identify, formulate and solve computer engineering problems; to be able to turn such requirements into an implementation plan, and to be able to define quality criteria for the deliverable results of such an implementation.  
|           | To design and conduct quality assurance experiments, as well as to analyze and interpret the results of such experiments. |

**Examples of assignments related to the outcome**

The following are examples of exam questions, lab assignments and/or documentation deliverables at the different content levels that the students must complete and that contribute to their progression towards achievement of program outcome b. These examples target a students ability to design experiments, to conduct them and to interpret data resulting from them.

**CMPE 140** – As part of a lab assignment, students were required to design and conduct functional and system level verification tests in the course of designing a 32-bit RISC CPU with a register file to execute a specific algorithm. The verification tasks were designed to analyze and interpret whether each module in the design is functioning appropriately on a component and system level. The following is the write-up of the assignment:

*Design a RISC CPU with 32 registers in its register file. The CPU is designed to execute a specific algorithm. The structural specifications of the CPU are given below: The CPU is WORD ADDRESSABLE. It reads data from an address space in data memory and stores it back to a different address space. The CPU contains the functional units ONLY*
pertinent to the algorithm. This CPU does not contain forwarding loops, therefore, it employs NOP instructions to avoid data hazards.

The following steps should be applied to achieve the design:

1) Construct a scalar CPU architecture that contains instruction and data memories, register file and ALU for this CPU.
2) Construct the timing diagram of the data-path.
3) Generate the control signals that are necessary for the normal flow of data.
4) Implement each module of this CPU using NC Verilog in Cadence design environment.
5) Perform functional verification on each implemented module. This task involves generating a test bench using NC Verilog, applying the test bench to the implemented CPU component, and comparing the outputs produced from the module with the expected results. The result of this analysis may result in re-implementing the CPU component.
6) Once the component level design and analysis is finished, connect the components according to the architectural schematic created in step 1 to create the scalar CPU.
7) Now, create a system level test bench using NC Verilog. Apply the test bench to the CPU, analyze the outputs of the CPU with the expected outputs at each clock cycle. This may require re-implementing the architecture by employing additional hardware blocks or altering bus connections.

Include component level, system level schematics, test bench inputs and outputs, timing diagrams in your report.

ISE 130 – In an examination question, students were asked how to interpret and analyze experimentation results for a given problem. The following is the write-up of the question:

Two different analytical tests can be used to determine the impurity levels in steel alloys. Nine specimens are tested using both procedures, and the results for the differences are: \( x_D = -0.2125 \) and \( s_D = 0.173 \). Is there sufficient evidence to conclude that both tests give the same mean impurity level, using \( \alpha = 0.01 \)?

a) What is unusual about the “original” parent distribution for this test, a fundamental difference between it and the parent distributions for the two-sample test?

b) What should be true about this parent distribution in order for the test to have more power than a two-sample test on the same numbers?

c) How do we transform the data for analysis?

d) What is the parameter of interest here, that is, what parameter is being tested? You may describe it in words or just use the correct notation.

e) What is the value of the estimate of that parameter?

f) What are the two of the three assumptions you must make in order to conduct this test?

**Conclusion**

The computer engineering curriculum is designed to enable the graduate to gain the outcome-b capabilities through both hardware and software laboratory/project components. Our program provides students an iterative and incremental learning experience in designing, conducting and interpreting their laboratory/project assignments.

The external feedback (e.g., the employer survey rates the alumni at 3.3 with respect to this outcome) as well as the students’ confidence levels (steady through the junior and senior surveys, significantly above that of the average peers institution) seems to confirm that our assessment that outcome b is well supported by the curriculum is valid.

**B.6.1.8.3 Program Outcome 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”.

Self-Study Report v8.doc
A computer engineering graduate must be able to understand the methodology for designing a component or a system, and contemporary hardware and software design tools to achieve this design in an effective way. He/she must be able to take into account the constraints imposed upon the design, be they technical, financial, regulatory or social in nature.

The students start their education with simple design challenges, with only a few degrees of freedom. These simple design choices may be technical in nature, or imposed by simple non-technical constraints. ENGR 10 is the first introduction to the design process, and it also teaches basic engineering tools used in the design. In ME 20 the design process is complemented with the requirement that a complete design be documented. In the introductory programming classes (CMPE 46 and 126) students are introduced to algorithm design and then to object oriented design concepts. In CMPE 126 the notion of complexity is explored, and students learn how to evaluate the influence of calculational constraints on a software design problem. In CMPE 110, 125, 127 and 140-sequence students acquire an understanding of how to approach transistor-level to system level hardware design challenges. The CMPE 130, 142 and 152 sequence complements the hardware sequence by focusing on the design issues in various software areas, ranging from data storage and retrieval to operating systems and compilers. CMPE 131 steps back from the specifics of a particular technology or software/hardware domain as such and works through the engineering principles and design processes as such, using software development as the vehicle for the exposition. ISE 130 contributes to the understanding of the entire design process by providing the students with the necessary tools and techniques for statistical analysis of experimental data.

The whole process culminates in the real life design project in CMPE 195 A & B where technical and non-technical constraints on the project have to be taken into account in the design process, and then re-addressed during the execution of the project towards its final deliverables.

The progression through the courses contributing to outcome c is

**Engineering Core Courses**

- CMPE 46 (CMPE 101) – teaches basic software design with C++ constructs.
- ENGR 10 – emphasizes two fundamental characteristics that are inherent in design: iteration and compromise. For a specific project, students are assigned to work in teams to develop a chart of the design process, define real world problems in engineering terms, search for and study existing solutions, develop constraints and criteria for evaluation, look for and analyze alternative solutions, make decisions considering the trade-offs between the various solutions, develop final specifications, and communicate the results.
- ME 20 – Teaches how to engage in a problem-solving process using AutoCAD for fundamental engineering designs and to create and document the design.

**Degree Required Courses**

- CMPE 110 – Teaches how to design simple and complex transistor-level CMOS, pass-gate and BiCMOS logic gates according to a specific design point: performance, area and power.
- CMPE 102 – Teaches the use of microprocessor instructions, memory access and protection mechanisms in the design of software/hardware systems. The students design, implement, debug and test assembler modules using 80x86 instructions.
- CMPE 126 – Provides basic knowledge to design applications using algorithms and data structures by employing object-oriented software design and programming methodologies. The course emphasizes an understanding the use of standard abstract data types and data structures in the design of simple software systems. The course teaches the students how to evaluate algorithmic complexity, and makes them aware of the constraints imposed on problem solutions by such complexity issues.
- CMPE 131 – Provides basic knowledge in software engineering and software engineering techniques. Students are taught how to complete a requirements analysis, identifying the desired features of a system to be delivered as well as the financial, societal and other constraints that project deliverables have to satisfy. They are also taught how to design to a requirements specification (including touching upon user interface design issues), and how to design for testability.
- CMPE 125, CMPE 127, CMPE 140 – This hardware sequence addresses design ranging from architecting and designing a digital system down to designing each component of such a sys-
tem. CMPE 127 emphasizes the operation and design of a digital block that consists of a CPU, memory sub-systems and peripherals all connected on a system bus. CMPE 140 examines the design details and operation of a pipelined CPU data-path and controller. It also addresses the how cache structures and other mechanisms may provide for an optimum CPU performance. CMPE 125 focuses on designing component level combinatorial and sequential hardware, functional verification and timing. All three courses emphasize hardware design process and methodology from component to system level.

- CMPE 130, CMPE 142, CMPE 152 – This software sequence addresses the design of file processing systems, operating systems and compilers. CMPE 130 focuses on how to design and implement systems for data storage and retrieval. CMPE 142 emphasizes concurrent processes and threads and their roles in program design. CMPE 142 emphasizes algorithms for scheduling and synchronizing processes and threads, methods for recognizing and addressing deadlock problems, and investigates different approaches to the management of a computer’s main memory. CMPE 152 focuses on the theory and design of finite state machines, recursive descent, production rules, parsing, and language semantics in handling text-based input components of software systems.

- ISE 130 – Provides statistical knowledge and skills, statistical techniques, processes, and tools to enhance the student’s ability to analyze engineering problems, designing solutions and interpreting data obtained for experiments. It requires students to write and document statistical formulas, analysis results, and reports for analysis and design of computer-related systems.

- ME 109 – Provides the students with a non-computer engineering set of design challenges, where they must address issues of chemical reactions systems within sets of realistic heat-transfer constraints.

- CMPE 195A & B – This course sequence emphasizes a hands-on approach on how to initiate, execute and complete a real-life project. CMPE 195A requires that each student team identify and provide the initial specification and design for a project, including engaging in the necessary research of the topic matter. They also have to generate a project plan, taking into account the limited resources available, the client’s constraints and other relevant regulatory or other limits on the project. In CMPE 195B the teams implement and deliver a prototype of the deliverable. This process integrates the students’ scientific, engineering, financial and social knowledge in the design effort, and the project pits the original design against the vicissitudes of real-life production and deployment requirements.

### Major courses: Specific contributions to the outcome

<table>
<thead>
<tr>
<th>Course</th>
<th>Contributions to the outcome arising from the course learning objectives</th>
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</table>
| CMPE 46 & CMPE 101 | To write effective C++ programs to meet the needs of project assignments.  
- To design programs with standard data types, I/O streams, structures, classes, and flow controls.  
- To design programs with friend functions and overloaded operator  
- To design programs with strings, and vectors.  
- To design programs with pointers and dynamic arrays.  
- To design programs with inheritance. |
| CMPE102         | To apply microprocessor instructions, memory access and protection mechanisms in the design of larger software/hardware systems.  
To design, implement, debug and test assembler modules of a hundred lines or more, using 80x86 instructions, floating point, Masm directives, macros, structs, etc. Assign homework problems by using:  
- Assembly fundamentals.  
- Strings, arrays, structs, macros.  
- Floating-point arithmetic and the FPU. |
| CMPE110         | To design simple and complex transistor-level CMOS gates according to a specific design point: performance, area and power. In particular,  
- To conduct experiments to size transistors in CMOS inverters and primitive gates (such |
<table>
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<tr>
<th>Course Code</th>
<th>Course Description</th>
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</table>
| CMPE125     | **To design and verify digital system building blocks.** To satisfy this objective students engage in lab projects:  
- To design and very basic to mediate-level combinational, sequential and storage building blocks.  
- To design and verify finite state machines (FSMs).  
To design and verify complete digital systems with mediate-level complexity, starting from specifications. To satisfy this objective students engage in lab projects:  
- To formulate an algorithm from a given specification, and then use ASM chart to describe the micro-operation of a digital system.  
- To interpret the ASM chart, and extract information from the ASM to formulate control (CU) and data path (DP) design problems.  
- To design and verify the partitioned CU and DP individually.  
- To integrate the overall system by combining the CU and DP.  
- To verify and analyze the integrated system, and perform diagnosis and bug-fix tasks. |
| CMPE126     | **To be able to apply fundamental concepts and practices in the areas of small scale software engineering.** To appreciate the importance of testing and reliability.  
To apply object-oriented software design and programming methodologies.  
- To identify the object models appropriate to a problem.  
- To identify the roles and responsibilities and roles of each object in a system.  
To be familiar with standard abstract data types and data structures, including stacks, queues, and linked lists, trees, and graphs, and the use of each in the C++ programming language.  
To be able to use of standard algorithm design strategies, e.g. recursion, hashing, searching, and sorting. |
| CMPE127     | **To implement a small scale microprocessor system consisting of a CPU, an interrupt controller, memory-subsystems, address and data bus.**  
To analyze a system architecture, CPU organization and its basic operating principles. Lab projects include:  
- To read and understand the datasheets, and translate the technical specification and system block diagram into actual processor and logical sub-systems.  
- To refine the design specifications and to design subsystems and basic building blocks to meet the technical specifications.  
To design data, address and control buses and their buffers and transceivers with the characteristics of uni-directional and bi-directional buses, and time multiplexing technique.  
To implement an I/O interface based on a 8255, a programmable peripheral processor.  
To implement a programmable interrupt controller based on a 8259.  
To generate formal technical specifications, formal report to document the engineering design and communicate with other effectively. |
| CMPE130     | **To design and implement systems for data storage and retrieval.** This objective is achieved by homework projects targeting:  
- To design and implement systems using I/O buffering.  
- To design and implement systems using sequential access.  
- To design and implement systems using indexed file access.  
- To design and implement systems using B-tree file access.  
To design a data storage system to meet a set of engineering specifications. |
<table>
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<tr>
<th>Course</th>
<th>Objectives</th>
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| CMPE131 | To configure basic software engineering objectives, principles, goals, needs before a design.  
To be familiar with software engineering life cycle and various process models.  
To plan and conduct a software engineering project in a supervised lab environment.  
To analyze and design software systems and generate software specifications.  
To conduct software analysis and design using learned software analysis models and design methods using modern software engineering tools using IBM Rational Rose. |
| CMPE140 | To design of a RISC instruction set and implement a generic RISC CPU using this instruction set in a supervised lab.  
- To configure a basic RISC instruction set and be able to write assembly type programs using this set.  
- To implement various individual CPU components.  
- To combine individual CPU components to create a CPU data-path, be able to implement and make modifications on this data-path.  
- To be familiar with SRAM topology, architecture, circuitry and control.  
- To be familiar with the principles behind cache memories, cache types, topology and trade-off. This step includes how to architect a direct-mapped, set-associative or fully-associative cache.  
- To be able to implement cache-read and write mechanisms and the circuitry. This includes the difference between a write-through and a write-back cache, the operation of each type and design of the required hardware. |
| CMPE142 | To be familiar with processes and threads and their roles in program execution through homework assignments.  
To study different algorithms for scheduling and synchronizing processes and threads, and learning to recognize and solve deadlock problems, which include different algorithms for scheduling and synchronizing processes and threads through homework assignments.  
To investigate and compare different approaches to the management of a computer’s main memory through homework assignments.  
- To learn about memory management basics.  
- To learn about paging and segmentation basics, and main implementation schemes commonly used.  
- To learn about page replacement algorithms commonly used and their implementation.  
To survey different techniques and technologies for file systems and data storage through homework assignments.  
- To learn about basic file and directory structures, and advantages and limitations of each.  
- To survey different storage technologies, and advantages and limitations of each.  
To learn and practice skills implementing the concepts, structures, and algorithms studied in the class using the C++ programming language, which include implementing the concepts, structures, and algorithms using the C++ programming language in several comprehensive programming projects through homework assignments. |
| CMPE152 | To setup working skills in theory and application of finite state machines, recursive descent, production rules, parsing, and language semantics in order to satisfy the outcome c component of the computer engineering curriculum in a supervised lab environment.  
- To construct symbol tables.  
- To construct syntax diagrams; recursive descent; parsing expressions. |
CMPE195A & B

To conduct and manage a computer hardware/software senior project using basic project planning and management. This topic includes how to utilize project planning and management processes and techniques.

To apply knowledge of design processes, and of computer hardware and software to the design of a computer engineering artifact. This topic includes how to deliver an artifact on time, on spec and budget.

To convert the design requirements into an implementation plan, and be able to define quality criteria for the deliverable results of such an implementation.

**Examples of assignments related to the outcome**

The following are examples of exam questions, lab assignments and/or documentation deliverables at the different content levels that students must complete and that contribute to their progression towards achievement of program outcome c. These examples target a student’s ability to design systems or components to meet a set of requirements, taking into account realistic constraints.

**ENGR 10** – Emphasizes two fundamental characteristics that are inherent in design: iteration and compromise. Students form teams in the class. Each team selects a specific topic such as “The perfect Coffee Cup”, “Earthquake-Resistant Bridge”, “Hearing Enhancer”, or “Wafer Encryption”. Each team is required to write a report on the following activities: (1) develop a flow chart of the design process, (2) define real world problems in engineering terms, (3) search for and study existing solutions, (4) develop constraints and criteria for evaluation, (5) look for and analyze alternative solutions, (6) make decisions considering the trade-offs between the various solutions, (7) and develop final specifications.

**CMPE 125** – In an examination question, students were asked to design a digital system to execute the greatest common denominator (GCD) algorithm. The C-code of the algorithm and the design library elements were a given. It was required that the system’s data-path (DP) be constructed based on the building blocks of this library. The question had six parts:

1. asked for micro-architecting the data-path.
2. asked for all I/O interface signals between the data-path and the control blocks.
3. asked for the finite state machine that constituted the control logic.
4. asked for the ASM chart that described cycle-by-cycle system operation.
5. asked for the control outputs produced at each cycle.
6. asked for the waveforms on the data-path and the control unit.

**CMPE 195A** – The students are required to deliver a project design specification document, which includes sections on constraints such as imposed by the end-user environment, regulatory and standards compliance issues, and financial limitations as well as more directly technical constraints such as speed, interface compatibility and the like.

**Conclusion**

Understanding the principles of design and to be able to design, implement and verify a system and its components using contemporary hardware and software design tools and methodologies are the foundations of computer engineering. Students successively take a series of design-oriented hardware and software courses during their undergraduate study; for each new course, they are required to apply their knowledge of previous coursework to understand the fundamental design principles. This method culminates in a successful senior design project.

The employer survey rates the graduates at 2.8. This is a satisfactory rating, but it is indicative of there being room for improvement. The employers’ experience is with graduates some years after their graduation, and recent improvements in the senior design courses are not likely to have propagated sufficiently far into the alumni population to influence this rating yet.

The engineering exit study seems to indicate that the 2005 program graduates are significantly more confident of their ability to perform design tasks than graduates from the peer institutions are. This may be reflective of the improvements of the program that we have recently engaged in.

Though outcome c is well supported by the curriculum as assessed, we are keeping an eye on this outcome and will re-assess in particular how the recent changes affect our graduates’ design capabilities.

**B.6.1.8.4 Program Outcome d**

“An ability to function on multi-disciplinary teams”.

A successful computer engineer will work closely with other professionals in team structures, in hierarchies and in client-service provider relationships. People skills in general and a practical understanding how to work in teams and with people from multiple disciplines in particular is a competency we nurture in our students as they proceed through the curriculum.
The faculty holds that a professional understanding of teamwork skills have to be secured through actual teamwork – complementing conceptual understanding with practical experience is a key didactic method in teaching engineering, and the same method carries over into the teaching of teamwork as well.

The foundation for an understanding of how to work with people from other disciplines is established through the general education (areas D1, D2, D3, R, S, V and Z) and science components of the curriculum (see table B.3.6.1). There students of diverse academic backgrounds find themselves working together in the class room as on shared projects.

The multidisciplinary aspect is then made solid through ENGR 10 and the engineering common core set of courses. In these courses students from the various engineering disciplines work together on project teams, addressing design and implementation challenges from a range of disciplines spanning other engineering pursuits in addition to computer engineering. The issue of multidisciplinary communication is also addressed in ENGR 100W, the required technical writing class.

The dynamics of teamwork is explored and practiced throughout the upper division curriculum, with team projects being a common component in the laboratory courses and in many of the homework assignments. The culminating of this learning experience is in the capstone project, where teams of students bring together computer science, electrical engineering, computer engineering and management to complete a year-long team project.

As the students progress through the curriculum they demonstrate that they

- possess a conceptual understanding of group dynamics, that is, how to make groups work effectively. This conceptual understanding includes:
  1. how to create a group climate that encourages success,
  2. how to recognize and make effective use of power resources in group activities, and
  3. how to use communication strategies for dealing productively with conflict.

- can participate effectively as team members in long-term group projects:
  1. working cooperatively with others,
  2. accepting divergent views,
  3. encouraging active participation of others,
  4. dealing productively with conflict, and
  5. taking leadership roles as the need arises to accomplish the group’s objective;

- can work successfully with people who are in other fields and those who perform a variety of functions within a group. This means that they must:
  1. exhibit respect for these people and the diversity they bring to the group,
  2. be able to accept and incorporate, where appropriate, ideas from people with different perspectives; and
  3. be able to explain pertinent engineering principles and applications to people who have no training in those principles and applications, but who need to make use of them.

The progression of the student through the curriculum to achieve outcome d:

**General Education Courses**

- The general education requirement provides the students with a broad appreciation of other disciplines outside the engineering domain, including the humanities. The general education component lays the foundation for the ability to work with people from other disciplines, and provides for an appreciation of highly divergent perspectives on the human experience.

**Engineering Core Courses**

- ENGR 10 – gives students a taste of engineering through hands-on design projects, case studies, and problem-solving. Students learn about the various aspects of the engineering profession and acquire communication and team skills.

**Major Required Courses**

Student teams are used throughout the required courses of the curriculum – as ad hoc learning organization models, as more structured problem solving, design and implementation organizations, and as
subjects for study in their own right. Among these courses the following sets serve as examples of three different learning experiences supporting outcome d:

- **ENGR 100W** – provides students with a practical understanding of how to communicate orally and in writing. The subject matter used as a vehicle for the writing exercises is environmental factors as they relate to products, systems and engineering processes. The course supports outcome d through its use of a non-computer engineering domain to teach interpersonal technical communication, and through the teaching of a core team skill – the ability to communicate effectively.

- **CMPE 110, 125, 127, 131, 140, 142, 152** – courses use active group learning. Students are required to work in teams of two or three students on project or homework assignments. The experience reinforces how teams leverage achievement, and in particular it supports the use of teams as mutually supportive learning environments. CMPE 131 (Software Engineering I) provides the students with design and planning concepts that are required for successful team formation and project execution.

- **CMPE 195A & B** – in the capstone project experience the team is the organizational centerpiece. Students form teams, evaluate and select projects, and then plan and work through the project requirements elicitation, design, implementation and delivery cycle. During the year-long course the students are adopting different roles within a team structure, have to create project plans that identify the roles of each team member and their respective obligations and deliverables, and in the end they have to reflect and evaluate their contribution to the team experience as well as to reflect on the overall teamwork.

### Major courses: Specific contributions to the outcome

<table>
<thead>
<tr>
<th>Course</th>
<th>Contributions to the outcome arising from the course learning objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 010</td>
<td>To expose the students to several engineering disciplines through problem solving for the purpose of providing information to assist them in their choice of major. To provide opportunities for students to practice communication and team skills.</td>
</tr>
<tr>
<td>ENGR 100W</td>
<td>To communicate effectively with computer engineers and with professionals of other domains of expertise. To explore and communicate findings within a domain of expertise outside their own major area.</td>
</tr>
<tr>
<td>CMPE 131</td>
<td>To learn how to plan, conduct, and manage a software engineering project. To practice team formation, and collaborative, goal-oriented teamwork.</td>
</tr>
<tr>
<td>CMPE 110, 125, 127, 131, 140</td>
<td>To practice teamwork in laboratory and homework assignments.</td>
</tr>
<tr>
<td>CMPE 195A &amp; B</td>
<td>To learn how to work as an effective team player in a project team To communicate with each others using various communication skills. To acquire the skills to develop and manage a computer hardware/software project using basic project planning and management techniques. To be able to reflect on one’s colleagues’ and one’s own contributions to a team effort.</td>
</tr>
</tbody>
</table>

### Examples of assignments related to the outcome

The following are examples of exam questions, lab assignments and/or documentation deliverables at the different content levels that the students must complete and that contribute to their progression towards achievement of program outcome d. These examples target a student’s ability to function in teams, and to function in teams working with partners from other disciplines.

**ENGR 10** – Students from various majors were assigned to form teams by the instructor. Each team has a captain, a recorder, a spokesperson, and a reflector. The roles must be rotated among the team members. Students are required to learn and practice team and small group communication skills. Each team engages in several problem-solving projects. At the end of each project, each team must submit a project report along with each member’s peer evaluation of the other members.

**CMPE 131** – In an examination question, students were required to understand the organization, management and process issues associated with project teams to familiarize themselves with team envi-
ronments they will be working with in their professional careers. The following are write-ups of two questions students must answer for these issues:

1) You have been appointed as a project manager to develop a bank ATM system. Your team has a lot of experience on creating similar types of systems. In addition, you have many reusable software components and modeling tools to support your processing activities, including business analysis, data modeling, process modeling, and program generation. You have a very tight project schedule. Please select a suitable linear sequential process model to work on the project, and provide your justifications.

2) Assume you have been appointed as a project manager for a project. Please select a team structure based on the following situations:
- The project is a very complex project with a tight schedule.
- The project requirements are well-defined and given.
- Since all members of the team are experienced consultants and senior engineers, each member is able to complete their task individually.
Please identify a team structure for this project and give your justifications. Please use a diagram to present the team structure.

ENGR 100W – Students from the different engineering disciplines work together on a research project teams. Each team selects a topic from the syllabus and generates a research paper, as well as make an oral presentation. Some topics of the team projects are:

CMPE 195B – Students are required to work in teams of two to three students. Besides the deliverables of the project itself and its associated documents (requirements, design, status reports, etc), after completing the project they are required to provide a team and an individual project post mortem analysis. One of the questions they have to address is to evaluate the participants’ contributions (including their own):

Your project’s success
Think back to the beginning of the semester, and the goals you set for your project at that time.
Did you achieve all these goals? Give a short argument for your answer, and if there were shortfalls, identify them and their cause(s).

Your contribution
A. Describe the skills you brought to the projects, your contributions to the project, and how well you applied your computer engineering skills.

B. Assume your answer in (2A), and a grade scale from 1(lowest) to 5(highest) where the meaning of the scale is:
5 = Work completed exceptionally well and on time.
4 = Work completed satisfactorily and on time (or perhaps exceptionally well and late.)
3 = Work completed, but less than satisfactorily
2 = Work not completed, but you have a satisfactory work ethic and attitude.
1 = Work not completed; you have an unsatisfactory work ethic or attitude.

What grade would you think most accurately reflects your contribution to this course’s project? Argue your case based on the grade interpretation above. Give specific evidence supporting your argument, and cite the literature where appropriate.

Your project members’ contribution
For each of your project members:
List his/her name and assigned responsibilities
Describe her/his specific contributions to the project, and how well s/he applied her/his computer engineering skills, using the same scale as in 0 above.

Your project advisor’s contribution
Provide an evaluation of your advisor’s contributions to the project.
Point to specific examples supporting your conclusion.

Conclusion
The practical understanding of how to work in teams and how to work in a multidisciplinary setting is central to a computer engineer’s professional career.
The students are repeatedly exposed to the challenges of understanding non-engineering domains of knowledge, and the domains of other engineering disciplines. They are also required to work in team settings with students from their own and from other disciplines to achieve tasks and assigned objectives.

The students are repeatedly assigned tasks and project in a team context, and the senior capstone project is the culmination of this learning experience, where the students form teams, assign themselves a project and its objectives, plan the execution of the project and are held jointly and individually responsible for their contributions to the teamwork. It is noteworthy that the students confidence increases significantly across their last year, as seen in the junior and senior surveys.

The employer survey rates the graduates at 3.3.

The engineering exit study seems to indicate that the 2005 program graduates are significantly more confident of their ability to perform design tasks than graduates from the peer institutions are.

We conclude that outcome d is well supported by the curriculum.

B.6.1.8.5 Program Outcome e

“An ability to identify, formulate and solve engineering problems”.

A computer engineering graduate must be able to identify, define, analyze, and represent problems related to computer engineering. A graduate must also be able to apply engineering principles and mathematics to find the unknowns, perform tradeoff studies, and arrive at appropriate solutions to the problem.

All engineering and science courses have the components of teaching problem formulation and solution. The majority of the exams, homework, projects, and labs are given to the students to identify, formulate and solve engineering problems.

Our curriculum is designed to enable the graduate to gain the above capabilities through the integration of lecture and laboratory components. Through the curriculum progression, the students’ problem-solving capability gains maturity from solving close-end problems to solving more open-ended problems.

The students receive a solid preparation in mathematics and physics, where the students learn how to formalize descriptions using the tools of mathematics. In ISE 130 they learn how to capture statistical and probabilistic models, and in MATH 42 they are provided with the discrete structures tools necessary for appropriate modeling and reasoning about the digital and discrete subdomains of computer engineering.

In their sophomore year, students learn to formulate and write basic software programs (CMPE 46) as well as solve fundamental circuit problems (EE 98). The scope of their homework and project assignments increases as the students gain more knowledge of the principles, methods, processes, and tools.

In their junior year, students learn the techniques and tools for analyzing and solving problems related to digital and analog circuits (CMPE 101and CMPE 124), microprocessors, computer systems, and the interrelationships between hardware and software components (CMPE 125 and CMPE 127). Students learn how to analyze their design statistically (ISE 130) and document their design in project reports (ENGR 100W). Students also learn how to design, implement, debug, and test software programs including assembler modules, file processing systems, operating systems and application packages with emphasize on software engineering best practices (CMPE 102, CMPE 126, CMPE 130, CMPE 131, and CMPE 142).

In their senior year, students learn the techniques and tools for analyzing and solving problems of complex digital systems (CMPE 140) and compilers (CMPE 152). Students also are required to engage in a year-long senior design project to capstone the knowledge of theory, methods, processes, and tools provided by the compute engineering curriculum (CMPE 195A & B).

The progression through the course contribution to outcome e is

**Preparation Courses**

- MATH 30, 31, 32, 42 (the calculus sequence, discrete mathematics)
- PHYS 70, 71, or PHYS 50, 51, 52 (mechanics, electricity and magnetism)
- CHEM 1A (general chemistry)

**Engineering Core Courses**
• ENGR 10 – Students work as a team to apply knowledge of mathematics and engineering, practice problem solving techniques, use tools to identify, formulate, and solve simple engineering problems in labs.
• CMPE 46, CMPE 101 – Engage students in using an integrated development tool (Visual C++) to write and test simple software programs.
• EE 97, EE 98, EE101 - Teach students basic techniques and modern engineering tools for solving hardware problems

Degree Required Courses

• MATH 133A, and one of MATH 129A or 138 or 143C (diff. eq., linear algebra and others)
• ME 109 – Teach students about heat transfer issues in electronics design. Students learn how to recognize heat transfer problems, to formulate them using the appropriate mathematical formalisms and to address them through mathematical analysis based on material properties.
• CMPE 124 – Teach students techniques and tools for analyzing and solving digital and analog circuit problems. Students learn how to formulate their computer hardware design for lab assignments.
• CMPE 102 – Teach students to design, implement, debug, and test assembler modules.
• CMPE 126 – Teach students to formulate and solve programming problems with standard abstract data types and algorithmic techniques.
• CMPE 131 – Teach students how identify open-ended software engineering problems, and how to formulate requirements and designs using the UML formalization.
• CMPE 125, CMPE 127 – Enhance student’s capability to analyze problems and develop applications for microprocessors and computer systems.
• CMPE 130 – Teach students to solve engineering problems by formulating designs for projects that make use of techniques for data storage and retrieval. The students use mathematics to capture design aspects and to reason about them.
• ISE 130 – Provide statistical knowledge, techniques, processes, and tools to formulate and analyze engineering problems as well as analyzing and interpreting data obtained for experiments.
• CMPE 140 – Teach the students how to use modern engineering formalization languages such as NCVerilog to capture hardware designs (specifically CPU architectures).
• CMPE 142 – Teach the students to formalize and reason about concurrency issues, such as deadlock problems, and their solutions.
• CMPE 152 – Engage students in formulating and solving formal language recognition problems (e.g., compilers) with the knowledge of finite state machines, recursive descent, production rules, parsing, and language semantics.
• CMPE 195A & B – Engage students in capstone senior design projects to identify, formulate, and solve problems related to computer engineering with the knowledge of theory, methods, processes, and tools provided by the computer engineering curriculum. The projects are presented in a very open-ended way, and a key challenge for the students is to identify the specifics, capture the requirements in an appropriate formalization and to complete the project deliverables within the constraints identified by the students at the beginning (“solve” the engineering problem).

Major courses: Specific contributions to the outcome

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<th>Contributions to the outcome arising from the course learning objectives</th>
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<tbody>
<tr>
<td>ENGR 010</td>
<td>To apply knowledge of mathematics and engineering, practice problem solving techniques, use tools to identify, formulate, and solve simple engineering problems in labs.</td>
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<td>- Solve basic engineering problems with MATLAB and spreadsheets</td>
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<td>EE 097, 098, 101</td>
<td>To solve hardware problems with basic techniques and modern engineering tools</td>
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<td>Course</td>
<td>Objectives</td>
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<tr>
<td>CMPE 046</td>
<td>To identify, formulate and solve software-related problems with C++</td>
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<td>- Solve problems with object-oriented constructs, methodologies and tool (Visual C++).</td>
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<td>To define the problem, plan the solution with pseudo-code</td>
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<tr>
<td>CMPE 101</td>
<td>To identify, formulate and solve software-related problems with C++</td>
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<tr>
<td></td>
<td>- Solve problems with object-oriented constructs, methodologies and tool (Visual C++).</td>
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<tr>
<td>CMPE 102</td>
<td>To design, implement, debug and test assembler modules</td>
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<td>- Design assembler modules with 80x86 instructions, floating point, MASM directives, macros, structs, etc.</td>
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<td></td>
<td>To interconnect C, C++ and assembler modules.</td>
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<tr>
<td>CMPE 124</td>
<td>To design basic software programs with object-oriented software design and programming methodologies.</td>
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<td>To design simple software programs with standard abstract data types and data structures</td>
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<td>- Design programs with stacks, queues, and linked lists, trees, and graphs.</td>
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<td></td>
<td>To design simple software program with standard algorithmic techniques</td>
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<td>- Design programs with recursion, hashing, searching, and sorting.</td>
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<tr>
<td>CMPE 127</td>
<td>To formulate and solve engineering design problems by engaging experiments and implementation of microprocessor systems.</td>
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<td>To analyze system architecture, CPU organization and its basic operating principles.</td>
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<td>To design and build single-step-through sub-system to trace and track the CPU operation.</td>
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<td>To design and implement I/O interface based on 8255 (programmable peripheral processor) and 8259 (programmable interrupt controller).</td>
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<tr>
<td>CMPE 130</td>
<td>To design file processing systems with B+ trees, hashing, and co-sequential processing.</td>
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<tr>
<td>CMPE 131</td>
<td>To plan and conduct a software engineering project</td>
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<td>To identify various software engineering problems and solutions.</td>
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<td>To design software solutions with software modeling tool</td>
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<td>- Design software with IBM Rational Rose.</td>
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<tr>
<td>CMPE 140</td>
<td>To design CPU architecture in order to enhance the CPU performance</td>
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<td>- Modify the existing overall CPU architecture to avoid structural, data and control-type hazards in RISC CPUs.</td>
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<td>- Solve the data hazards due to multi-cycle ALU operations.</td>
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<td>- Design the CPU control circuitry, which controls a simple CPU pipeline with forwarding loops, and other</td>
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<tr>
<td>CMPE 142</td>
<td>To recognize and solve deadlock problems with different algorithms for scheduling and synchronizing processes and threads.</td>
</tr>
<tr>
<td>CMPE 152</td>
<td>To formulate and solve problems relate to compilers</td>
</tr>
<tr>
<td></td>
<td>- Solve compiler problems with the knowledge of finite state machines, recursive descent, production rules, parsing, and language semantics</td>
</tr>
<tr>
<td>CMPE 195A &amp; B</td>
<td>To use and select different solutions to solve problems</td>
</tr>
<tr>
<td></td>
<td>To identify, formulate and solve computer engineering problems: understanding requirements, be able to turn such requirements into an implementation plan, and to be able to define quality criteria for the deliverable results of such an implementation.</td>
</tr>
</tbody>
</table>

**Examples of assignments related to the outcome**

The following are examples of exam questions, lab assignments and/or documentation deliverables at the different content levels that the students must complete and that contribute to their progression towards achievement of program outcome e. These examples target a students ability to identify what the problem is to be solved and formulate the solution to the problem.
EE 98 – Students are required to formulate mathematical equations to represent the behavior of electrical circuits and solve the equations to derive the required values of current, voltage, and power based on various electrical principles such as Ohm’s law, Kirchhoff’s law, Thevenin theorem, Norton theorem, and Superposition theorem.

CMPE 131 – In an examination question, the student is required to identify data objects in a system and formulate the appropriate entity relationship (ER) diagram for the system given a set of constraints. The following is a write-up of the question:

According to the given requirements of the online shipping management system, complete the following questions:

Identify the following 6 data/objects in the system, and specify the basic essential data attributes for each of them.

- User
- Customer
- Manager
- Staff
- System Admin.
- Shipping request
- Package

Draw an ERD to represent the relationships among the following data/objects only. Please do this based on the given system constraints listed below.

- Customer
- Manager
- Staff
- Shipping request
- Shipping task
- Work sheet
- Package

System constraints:

- Each customer has one or more shipping requests.
- Each customer can track and search one shipping request at once.
- Each package only has one shipping request.
- A manager can assign many shipping requests and generate one shipping task.
- Each shipping task can process one or more packages
- Each staff has one or more shipping tasks.
- Each staff generates one working sheet after completing a task.

CMPE 142 – In an examination question, students must identify how to use counting semaphores for blocking operations and formulate and explain their solution. The following is a write-up of the question:

Write C++ code showing how you would implement the wait and signal operations of a blocking, counting semaphore. Implement the semaphore as a struct or class containing an integer variable and a queue. You may assume that you have at your disposal code which implements enqueue and dequeue operations, as well three functions void block( ), void wakeup(int pid), and int myPid( ). Block suspends the process that invokes it. Wakeup resumes the execution of the blocked process specified by parameter pid. myPid returns an integer representing the process ID of the process that calls it. Include comments explaining what the major sections of your code do and/or any implementation details that you do not completely code for any reason (e.g. lack of understanding, shortage of time, etc.).

CMPE 195A – The students are required to identify and formulate the requirements of a computer engineering project. A sample of the challenges they need to address is the formalization of the use cases using the formalization language UML:

Use cases and User Context Using UML

Each team must provide description of what your users do, how their need for the system arose, and what they would like to see to solve their problem. Use your imagination and put yourself in the user’s context.
Conclusion
The computer engineering curriculum is designed to enable the graduate to gain the outcome-e capabilities through the integration of lecture and lab components. With a strong emphasis on laboratory work and on the confirmation of concepts learned in the classroom by means of their immediate and practical application our program provides students with an iterative and incremental learning experience that prepares them well for a life of identifying, formulating and solving engineering problems. The employer survey rates the graduates at 3.3, providing strong support for the contention that our graduates are doing well in this outcome area. The engineering exit study seems to indicate that the 2005 program graduates are somewhat more confident of their ability to perform design tasks than graduates from the peer institutions are. The junior and senior surveys indicate an increasing sense of competence with respect to outcome e in the students as they progress through their last year. We conclude that outcome d is well supported by the curriculum.

B.6.1.8.6 Program Outcome f
"An understanding of professional and ethical responsibility".
A computer engineering student must be able to understand and comply with the academic integrity policy defined by the university. This includes understanding a professional code of conduct and applying such a code of conduct in their own course work, design projects and in their respective jobs. Computer engineering students gain the above capabilities through the required lower and upper division general education courses, through the repeated references to the codes of conduct in their courses, and in particular in the call for personal professional reflection in the capstone project class. Both at the beginning (ENGR 10), in the middle (ENGR 100W) and at the end (CMPE 195A&B) of their curricular career in the program the issue of professional and ethical responsibility is addressed directly and also indirectly through the structure and format of the course assignments. Most computer engineering courses stress the importance of intellectual property rights and professional honesty practices.

The progression through the courses contributing to outcome f is as follows:

**General Education Courses**
- Area A: Communication and the role of public communication in a free society
- Area E: Human understanding and development
- Area S: Self, Society and Equality

**Engineering Core Courses**
- ENGR 10 – Students are presented with engineering ethics case studies in which they discuss the ethical dilemmas that occur in different types of engineering applications. The student must write a report on one of these case studies.
- ISE 130 – As part of their introduction to statistics, students are confronted with the issue of statistical misrepresentation of data, and the important role of integrity in statistical analysis. In particular the course covers the issue of statistical outliers and the responsible handling of such data points.

**Major Required Courses**
- CMPE 195B – This course requires students to understand the importance of professional ethics in a team or a larger organization. Each student works in a team with diverse but complementary skill sets. Each team member depends on other members’ contribution for the success of the project, which means each member has to respond to the team’s needs in a timely manner. To maintain harmony in the team, duties for each member are equally distributed and monitored. Duplicating or copying a previous work is forbidden; the team is expected to generate a brand new work of its own at the end of the project.

**Major courses: Specific contributions to the outcome**

<table>
<thead>
<tr>
<th>Course</th>
<th>Contributions to the outcome arising from the course learning objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>To understand topics in ethics in public communication.</td>
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<tr>
<td></td>
<td>To understand topics in ethics in human understanding and development.</td>
</tr>
</tbody>
</table>
To understand topics in ethics in self, society and equality.

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 10</td>
<td>Students work as a team to exercise fundamental communication skills while designing a product, present class reports in oral and written formats, and are introduced to basic concepts of sound engineering practices and engineering ethics.</td>
</tr>
<tr>
<td>ISE 130</td>
<td>To understand the responsible use of statistics and statistical data.</td>
</tr>
</tbody>
</table>
| Cmpe195B | To understand the roles the deliverable artifacts may play in an organizational or larger setting.  
- To present the motivation for the project, and its broader context.  
- To converse about the broader role of engineering and of trends in engineering.  
To work in a team with complementary skill sets.  
- To respond to team needs.  
- To bring together the skills of a team.  
- To reflect on one’s colleagues’ contributions to a team effort.  
- To reflect on one’s own contribution to a team effort. |

Examples of assignments related to the outcome

The following are examples of exam questions, lab assignments and/or documentation deliverables at the different content levels that the students must complete and that contribute to their progression towards achievement of program outcome f. These examples target a student’s understanding of professional and ethical responsibilities.

ENGR 10 – Students from various majors were assigned to form teams by the instructor. Each team has a captain, a recorder, a spokesperson, and a reflector. The roles must be rotated among the team members. Students are required to learn and practice team and small group communication skills. Each team engages in several problem-solving projects. At the end of each project, each team must submit a project report along with each member’s peer evaluation of the other members. Some of the assigned projects are “Penny Launcher”, “Rubber-Powered Flying Machine”, “Design for Total Recycling”, and “Packaging-Cardboard Bridge”.

CMPE 195B – The students are required to address any ethical or professional conduct questions that may arise during their project work. An example from the final exam is a question that probes the student’s understanding of his/her responsibility to clients, team members and managers:

*Assume that you in a team of ten people, on an 18 month project.*
*After 12 months the status assessment indicates that you are behind schedule, roughly by 20%, due to unanticipated difficulties in implementing the chosen design.*
*What are your options to address this problem, which one would you pick, and why?*

Conclusion

Understanding and accepting professional ethics in school and at work are taught as a recurring theme throughout the program, with particular courses addressing the topic quite specifically. The employer survey indicates a rating of 2.9, and the national exit study indicates that our students are in line with the graduates of peer programs. The junior and senior surveys indicate an increase in the student’s awareness of ethical issues across their last year. We feel that outcome f is well supported by the curriculum.

B.6.1.8.7 Program Outcome g

“An ability to communicate effectively”.

Communication skills are consistently ranked by employers as one of the most important skills of a successful engineer, and they are complementary to the technical prowess necessary to establish a successful engineering career.

The computer engineering program has a very diverse student population, with a significant proportion of the students having English as their second (or even third) language. Throughout their career with the program, the students are provided opportunities to deepen and refine their understanding of and practical capability for communication in various media – particularly communication in writing, in impromptu oral exchanges and in more formal presentations.
Their preparation for a career of successful communication also requires their acquiring an understanding of the subtle roles of culture and socioeconomic background on the modes of human interaction and interpersonal communication.

As the students progress through the curriculum they demonstrate that they

- have learned and can make effective us of basic communication concepts, techniques and skills.
- have learned and understand how to write technical reports and documents.
- have learned and understand how to structure and present technical information to an audience.
- are able to communicate well with peers, supervisors and managers within the profession.
- have been exposed to the broad range of human experience and how it may influence modes of communication.

After evaluating feedback from employers of the program’s graduate, the department established in 2003 a communication task force whose charter was to evaluate the teaching of communication within the program, and suggest ways to improve it.

The recommendation was to establish three progressively more advanced levels of communication skills to be taught:

- The basic level – students understand the importance and need for communication capability, and they gain a fundamental mastery of communication skills and techniques.
- The intermediate level – students learn how to make use of various communication skills and techniques in classrooms and team projects, and demonstrate their mastery in class assignments, laboratory/project reports, class presentations, and team communications.
- The advanced level – students learn how to evaluate and improve their communication skills in an organizational context as team participants and in addressing professional communication needs.

At the college level a communication focus group was established to oversee the college-wide teaching of communication skills, and its feedback has resulted in evaluation changes and course improvements for ENGR 100W (Technical Writing).

The progression of the student through the curriculum to achieve outcome g:

**Preparation Courses**

- General Education areas A1, A2, C3 – Computer engineering students are required to take general education courses in three university designated areas particularly relevant to outcome g: Oral Communication (area A1), Written Communication 1A (area A2) and Written Communication 1B (area C3).

  For the oral communication requirement students may complete Communication Studies 20, which is designed to provide students with skills in effective public speaking. They learn how to research, organize, and develop content for different types of speeches, and learn vocal and physical presentation skills. In written communication 1B the students further refine their skills of critical and persuasive communicative, and do so in a context of diversity.

**Engineering Core Courses**

- ENGR 10 - Students work in multidisciplinary teams where they develop fundamental communication skills when working together to identify, formulate, and solve engineering problems. They present class reports in oral and written formats.
- ME 20 - Introduce students to engineering design using CAD tools. The communication aspect is focused on techniques to document engineering designs.
Major Required Courses

Throughout the curriculum, students are repeatedly required to make presentations, to maintain laboratory and design notebooks, and to write reports in response to design requirements or other engineering challenges.

The role of IP rights, intellectual integrity and the professional framework defining plagiarism are also covered in depth and repeatedly.

A sample of courses at the various levels and their contribution to the outcome:

- **CMPE 126** – In the data structures class the students further refine their understanding of communication modes and appropriate uses of stylized communication through the course requirement that they provide internal documentation of the software assignments.

- **CMPE 110** – Similarly this class teaches students how to document their computer hardware designs (another formal domain communication context) and the students are required to provide written logs and reports for laboratory assignments.

- **CMPE 130, 131** – In these software design and engineering classes the students learn how to write project planning, design and user-oriented documents for a team project. They also practice effective interpersonal communication skills within their teams, and are provided with opportunities for public presentations.

- **CMPE 140** – Students move to the next level of professional design communication, through their written documentation of more complex hardware design projects.

- **ENGR 100W** – Engineering Reports is an upper division technical writing course. This course is required for all engineering students. Completion of the core general education requirement and passing the Writing Skills Test (WST, a lower division college level writing test) is required prior to enrollment in ENGR100W. Students typically take this course in their junior year. In-class writing, assessment, and feedback are carried out weekly.

In addition to written communication per se, the students are given a thorough introduction to the definition of plagiarism, an understanding of what is allowable fair use and what constitutes a breach of professional integrity. This review of the framework of intellectual integrity is the standard against which students are held responsible in their writing in this and other classes in the major.

The College of Engineering also offers a writing clinic (ENGR 90W), open to all engineering students. This clinic was implemented in order to assist students needing basic English skills.

ENGR 100W is assessed both externally and internally: The course requires an exit exam administered at the end of each semester. And the exams are graded by an external evaluator who assesses the single-topic general essays based on features such as organization, clarity, consistency of point of view, cohesiveness, appropriateness of diction and syntax, and correctness of mechanics and usage. Students failing the exit exam are given a No Credit grade in the course.

The course is assessed internally through the process of certification by the University Writing Requirements Committee and the Board Of General Studies. In 2003 both committees granted another three year approval for ENGR 100W to meet university Area R (earth and environment) and Area Z (communication) advanced GE requirements.

- **CMPE 195A & B** – Students are required to write essays on seminar topics such as engineering ethics, life planning, engineering solutions in a social and global context, and contemporary issues. In addition, seminars on effective technical presentations and interview skills are also given. The deliverables for the course include a journal style article, a project description, a project development plan, a requirements specifications document, a project status report, a user manual, two technical presentations and a project post-mortem retrospective (both on a team and individual basis). Students are also required to maintain an engineering notebook for the course, and the notebook servers as part of the grade basis.

All the reports are graded on the quality of presentation as well as technical content. The reports are graded by a technical writing faculty member and by a computer engineering faculty member. Students whose communication skills warrant attention are sent to tutoring sessions and are offered a structured tutoring environment through enrollment in the class ENGR 90W (Technical Writing Workshop). Students may resubmit new versions of their reports after responding to feedback and assistance from the instructors. This feedback allows students to recognize and correct writing process deficiencies they may have. At the end of the project, students are required to present their projects on the Engineering...
Student Conference Day (when students from all engineering departments make their senior project presentations). Students’ guests and industry practitioners are invited to this event. An evaluation is conducted by faculty members, students, and industry participants.

### Major courses: Specific contributions to the outcome

<table>
<thead>
<tr>
<th>Course</th>
<th>Contributions to the outcome arising from the course learning objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education areas A2, A3, C3</td>
<td>To practice public speaking, organizing written and oral critical and persuasive communication, understand diversity as a communication backdrop.</td>
</tr>
<tr>
<td>ENGR 010</td>
<td>To practice basic multidisciplinary engineering communication</td>
</tr>
<tr>
<td>ME 020</td>
<td>To engage in technical and design communication</td>
</tr>
<tr>
<td>CMPE 110</td>
<td>To write laboratory reports, formal communication: basic hardware design write-ups.</td>
</tr>
<tr>
<td>CMPE 126</td>
<td>To communicate with fellow engineers or customers verbally, or through technical reports, diagrams, users’ manuals. To practice basic formal communication: basic software algorithm documentation.</td>
</tr>
<tr>
<td>CMPE 130</td>
<td>Be able to communicate with fellow engineers or customers through technical reports and design documentation.</td>
</tr>
<tr>
<td>CMPE 131</td>
<td>To be able to present analysis and designs of software systems and to capture in writing software specifications. To be able to engage in appropriate communication modes in a team project.</td>
</tr>
<tr>
<td>CMPE 140</td>
<td>To be able to communicate using a variety of technical professional writing formats.</td>
</tr>
<tr>
<td>ENGR 100W</td>
<td>To be able to refine the competencies established in written communication 1A &amp; 1B</td>
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<td></td>
<td>To be able to express (explain, analyze, develop and criticize) ideas effectively, including ideas encountered in multiple readings and expressed in different forms of discussion.</td>
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<td></td>
<td>To be able to organize and develop essays and documents for both professional and general audiences, including appropriate editorial standards for citing primary and secondary sources.</td>
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<tr>
<td></td>
<td>To be able to communicate using a variety of technical professional writing formats.</td>
</tr>
<tr>
<td>CMPE 195A &amp; B</td>
<td>To be able to use appropriate communication methods and skills to work within a project team.</td>
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<td></td>
<td>To be able to communicate designs, implementation plans, project reports and project retrospectives at a budding professional level.</td>
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<td></td>
<td>To present a project, its genesis and the engineering and other considerations taken into account during the project period.</td>
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<td></td>
<td>To reflect upon a project and to present an evaluation of the experience, post mortem.</td>
</tr>
</tbody>
</table>

### Examples of assignments related to the outcome

The following are examples of exam questions, lab assignments and/or documentation deliverables at the different content levels that the students must complete and that contribute to their progression towards achievement of program outcome g. These examples target a student’s ability to communicate effectively in written and verbal forms.

**CMPE 130** – In all lab project assignments students are required to write a lab report to describe the purpose of the project, constraints to the project, design of the project, test planning and results, a conclusion of what they learning in the project and a list of their references. The following is a write-up of the lab report format:

> The report format should be structured in numbers sections 1–7 including a table of contents and the following items:
> 1. Abstract
> 2. Problem Statement
Description of problem
User interface
Constraints on implementation

3. Design and Method
Top-down discussion of design
Class definitions
Major functional blocks
Special C++ features used
Problems encountered and solutions thereto

4. Test Plan and Test Results
5. Cost Analysis (breakdown of hours worked)
6. Conclusion (What did you learn from this project?)
7. References (include websites, other sources of pseudo-code)

CMPE 195A – The students are required to write about their project in three different formats:
The deliverables for the course include a project description (in the form of a journal article), a
development plan (in the form of a time-line oriented resource management plan), and a require-
ments specification (in the form of a technical report based on the RUP model).

Conclusion
The practical understanding of how to communicate appropriately and effectively is an important career
skill for a computer engineer.
The employer survey indicates a rating of 2.9, and the national exit study indicates that our students are
significantly more confident in the communication area than the graduates of peer programs. The junior
and senior surveys indicate a strong increase in the student’s perception of their own communication capa-
bilities.

Since the employers’ experience is with students graduating across the last decade, we feel that the recent
graduates are likely to exceed the most recent (and satisfactory) rating, since a number of improvements in
the communication area have been implemented over the last few semesters.

Ethics and professional responsibility was the main topic for the focus group for the spring 2005 graduating
class. The topic was probed extensively, and the students demonstrated a good understanding of how their
obligations to themselves and to society, as well as being able to discuss subtleties of ethics in a profes-
sional context.

Based on the curriculum assessment, the students’ feedback and that of alumni and employers, we conclude
that outcome g is well supported by the curriculum.

B.6.1.8.8 Program Outcome h
“The broad education necessary to understand the impact of engineering solutions in a global, economic,
environmental and societal context”
A computer engineering graduate must be able to

- Demonstrate the understanding of their professional ethic to recognize the engineering practice and
  solution are connected to the global and social context, and to realize where the engineering solution
  may have social and global impact.
- Conduct engineering practice and provide engineering solutions with full awareness of the environ-
  mental, social, and economic issues.
- Engage in a consistent, higher standard engineering practice, and to be able to identify and resolve the
  potential areas where the challenges may arise. Have the ability to present and to convince the peers in
  the process of the engineering practice and resolving engineering solution.

The mandatory English Writing Competency class (ENGR 100W) addresses the impact of engineering
solutions in a environmental context. Furthermore, students must address the relevant global, economic,
environmental and societal concerns in their senior design projects (CMPE 195A & B).

The progression through the course contribution to outcome h is

General Education Courses
- Area C (Humanities & arts)
- Area D (Social science)
• Area V (Culture, civilization, & global)
• Area S (Self, society & equality)
• (The remaining areas are certified by the university to be covered by ENGR 100W and the program’s mathematics, science and engineering curriculum)

Degree Required Courses
• ENGR 100W – Apply a scientific approach to answer questions about the earth and environment.
• ME 109 – Apply knowledge of heat transfer properties in the design of electronic devices in evaluating the environmental impact of the materials used. Similarly, to be able to appreciate the labor issues involved in materials choice.
• CMPE 195A & B – The students attend a biweekly seminar series on technology, society and leadership where speakers from Silicon Valley and global corporations are invited to share their perspectives with the students. The students are required to discuss the broader impact of their projects (as appropriate), and in the second semester they are required to discuss the broader context in which they will engage their professional lives.

Major courses: Specific contributions to the outcome

<table>
<thead>
<tr>
<th>Course</th>
<th>Contributions to the outcome arising from the course learning objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Edu-</td>
<td>To understand topics in humanities and arts (Area C)</td>
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<tr>
<td>cation</td>
<td>To understand topics in social science (Area D)</td>
</tr>
<tr>
<td></td>
<td>To understand topics in culture, civilization, and global (Area V)</td>
</tr>
<tr>
<td></td>
<td>To understand topics in self, society and equality (Area S)</td>
</tr>
<tr>
<td>ENGR 100W</td>
<td>To apply a scientific approach to answer questions about the earth and</td>
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<td>environment</td>
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<tr>
<td>CMPE 195A&amp;B</td>
<td>To understand the impact of engineering solutions in a global, economic,</td>
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<td></td>
<td>environmental and societal context</td>
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<td></td>
<td>- Attend Silicon Valley Leader Symposium to learn global and economic</td>
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<td>context</td>
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<td>- Engage in global market research to justify the project undertaken</td>
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<td>as the senior design</td>
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<td></td>
<td>- Include the economic justification as part of the budgeting section</td>
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<td></td>
<td>of the senior design report</td>
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</tbody>
</table>

Examples of assignments related to the outcome
The following are examples of exam questions, lab assignments and/or documentation deliverables at the different content levels that the students must complete and that contribute to their progress towards achievement of program outcome h. These examples probe a student’s broader understanding as an educated member of society.
ENGR 100W – Students from teams are required to do research on environmental topics such as “Landfill Gas Recovery Proposal”, Hydrogen Powered Vehicle Research and it’s Future Challenges”, and “Designer Plants for the Environment”. They have to find information on current research and technologies in very specific applications. They are encouraged to look for local applications. Then give a short presentation of their findings. They have to synthesize information as well as organizing the presentation. Furthermore, students write an internal technical proposal based on their findings.
CMPE 195B – The students are required to

  Write an individual professional plan
  The plan should address: (1) Where do you expect to be professionally in five years? (2) How do you expect to get there? (3) How does the globalization (and in particular outsourcing) of your profession influence your plan? (4) What are the risks, and how are they addressed?

Conclusion
The computer engineering curriculum is designed to enable the graduate to achieve outcome h through both general education courses and three upper division major courses.
The employer survey indicates a rating of 2.8, and the national exit study indicates that our students are in line with the graduates of peer programs. The junior and senior surveys indicate an acceptable confidence level among the students.
Since the employers’ experience is with students graduating across the last decade, we feel that the recent graduates are likely to exceed the above (though satisfactory) rating, since a number of improvements in the communication area have been implemented over the last few semesters. We conclude that outcome h is well supported by the curriculum.

B.6.1.8.9 Program Outcome i
“A recognition of the need for, and an ability to engage in life-long learning.”
There are two parts to this criterion; the recognition and the ability for life-long learning. To meet criteria i, our graduates should show that

1. they recognize the importance and necessity of keeping their domain knowledge and technical skills up to date.
2. they recognize the need to maintain and enhance their professional practice of computer engineering.
3. they recognize that graduation is the first step in their development of professional engineering competency.
4. they are able to acquire new technical skills and knowledge on their own – to be able to learn outside a classroom setting.

In computer engineering the profession goes through frequent convulsions of innovation, and a successful professional must be a self-starting learner, always interested in forging ahead, to identify strategic directions of knowledge development and to be interested in and capable of reinventing her professional profile a number of times during her career.

Curriculum Progression towards the Outcome
There are three core elements required for the student to achieve this outcome:

1. A solid foundation upon which further learning can occur.
2. A compelling and internalized understanding of the rapid change of the profession, and
3. A guided introduction to the need and the techniques necessary for self-directed learning.

The first factor is well integrated into the curriculum, with its emphasis on fundamental mathematical and engineering concepts and applications, and the development of a solid foundation in the specific domain of computer engineering. And the preparation goes broader than the computer engineering domain – the foundation encompasses an understanding of humanity and its physical, historical and philosophical context that encourages the flexibility of perspective and the agility of mind necessary for the student to successfully meet life’s professional challenges and changes – the graduates of the program are unlikely to stay within the confines of the computer engineering profession through their whole career.

The second factor is reinforced through references by instructors and the curriculum to the rapid change in the computer engineering field, and the students’ own experience of these changes even within their own (albeit short) experience with information technology.

The third factor is addressed through the development of the students’ maturity as they move towards graduation. From the close guidance and detailed instructions of the Frosh year to the self-directed choice of partners, projects and project strategies of the senior project, the students are gradually encouraged to take charge of their own lives and aspirations.

The process of moving the students towards intellectual independence is so pervasive throughout the curriculum that the exposition of specific courses here is limited to the first and last stages of the student’s progress:

Preparation Courses

1. General Education Areas C, E, V, S – students are opened up to the broad expanse of human experience, and the range of options available to each individual in their life- and career decisions. The students are exposed to the role of change in human society, and by extension the likelihood of significant change affecting their own lives.

Engineering Core Courses

1. ENGR 10 – students are exposed to the range of engineering professions, their interaction and to the need to understand terminology and concepts outside their own domain.

Major Required Courses
• CMPE 195A & B – this is the endpoint of the students’ journey towards self-direction and the starting point for their life of independent pursuit of knowledge. In the senior project the students are expected to choose their team partners, their project and their plan for project execution with minimal direction from the instructor. The students are guided with respect to the process of how to identify and consider alternatives rather than the alternative per se.

The students are required to identify knowledge lacunae, and to independently identify the knowledge sources necessary for the successful completion of their projects. The students are also required to evaluate potential risks and their avoidance (or mitigation), and thus encouraged into adopting a forward-looking professional attitude. At the end of the course the students submit a report where they reflect upon their project experience, and thus strengthen their understanding of self-evaluation and reflection, encouraging future professional and personal growth.

In addition to the project at the core of the course, the students are required to develop a personal plan for the next five years of post-graduation professional life, nurturing an attitude of personal reflection.

In parallel with the project work, the students attend a seminar series where technological, research and corporate leaders of Silicon Valley share their experiences and their visions for the future. The seminar series underscores the rate of change in the profession and encourages an attitude of positive excitement w.r.t. new knowledge and technological change.

<table>
<thead>
<tr>
<th>Major courses: Specific contributions to the outcome</th>
<th>Contributions to the outcome arising from the course learning objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education, Areas C, E, V, S</td>
<td>To identify the historical context of ideas and cultural practices and their dynamic relations to other historical contexts;</td>
</tr>
<tr>
<td></td>
<td>To explain how a culture changes in response to internal and external pressures.</td>
</tr>
<tr>
<td></td>
<td>To describe historical, social, political, and economic processes.</td>
</tr>
<tr>
<td></td>
<td>To recognize the physiological, social/cultural, and psychological influences on their well-being;</td>
</tr>
<tr>
<td></td>
<td>To recognize the interrelation of the physiological, social/cultural, and psychological factors on their development across the lifespan;</td>
</tr>
<tr>
<td></td>
<td>To be introduced to basic research strategies, including locating materials, evaluating them, using them effectively, and citing them properly</td>
</tr>
<tr>
<td>ENGR 010</td>
<td>To expose the students to several engineering disciplines through problem solving for the purpose of providing information to assist them in their choice of major.</td>
</tr>
<tr>
<td></td>
<td>To provide opportunities for students to practice communication and team skills.</td>
</tr>
<tr>
<td>CMPE 195A &amp; B</td>
<td>To acquire the skills to develop and manage a computer hardware/software project using basic project planning and management techniques.</td>
</tr>
<tr>
<td></td>
<td>To be able to reflect on one’s colleagues’ and one’s own contributions to a team effort.</td>
</tr>
<tr>
<td></td>
<td>To be able to converse about the broader role of engineering and of trends in engineering</td>
</tr>
</tbody>
</table>

Examples of assignments related to the outcome
The following are examples of exam questions, lab assignments and/or documentation deliverables at the different content levels that the students must complete and that contribute to their progression towards achievement of program outcome i. These examples target a student’s recognition and ability to engage in life-long learning.

ENGR 10 – A lecture was specifically dedicated to the topic of lifelong learning. Students were assigned homework to answer questions such as “Why did you choose to study engineering?”. “What are the newest engineering disciplines? How did they emerge?”, and “Find out as much information as possible on local student chapters of professional engineering societies in your area of interest. Apply to join one of these.”

CMPE 195B – The students are required to

Write an individual professional plan

The plan should address: (1) Where do you expect to be professionally in five years? (2) How do you expect to get there? (3) How does the globalization (and in particular outsourcing) of your profession influence your plan? (4) What are the risks, and how are they addressed?
**Conclusion**

The recognition of the need for continued professional development, and the ability to sustain such a development through a professional career is an absolute for a computer engineer.

The students are repeatedly provided with the tools for independent learning, and increasingly exposed to the need for independent knowledge pursuit and career self-direction.

They are also repeatedly confronted with evidence of the rapid change in the IT field in general and in computer engineering in particular.

The employer survey indicates a rating of 2.8, and the national exit study indicates that our students are in line with (slightly above) the graduates of peer programs. The junior and senior surveys indicate an adequate confidence level with respect to outcome i, and their confidence seems to be confirmed by the fact that the alumni survey indicates that 53% of the respondents have enrolled in further study within two years of graduation.

We feel that the curriculum well supports outcome i.

**B.6.1.8.10 Program Outcome j**

“A knowledge of contemporary issues”.

The students need to understand the context in which they will be working, both in their profession and in society and the world as a whole. An understanding of contemporary issues then is a societal as well as technological objective for the program.

The general education program addresses the knowledge of contemporary issues under various perspectives from the broadly societal to the more narrowly technological. The program covers the rapid pace of change and the contemporary directions of the technology development, and addresses the broader issue of direction through seminar series with leaders and visionaries of Silicon Valley.

Students are also offered the opportunity to engage in the political, social and professional activities of the university, through student societies focusing on the profession (IEEE/CS, Society of Women Engineers), on social and ethnic background and more broadly on the life of the university and surrounding communities.

In the curriculum contemporary issues are explicitly brought into the major courses at the early, middle and senior levels, in ENGR 10, ENGR 100W and in CMPE 295A & B, as well as being addressed in the general education program (areas A, C, D and E).

The major courses discuss the relevant contemporary issues and trends – we provide CMPE 142 (Operating Systems) as an example below.

**General Education**

- General education area D covers contemporary issues in depth.

**Degree Required Courses**

- CMPE 131 – This course provides knowledge of software engineering processes. When covering the requirements processes the student is made aware of the regulatory and other non-technical constraints that may influence a design process.

- ENGR 100W – This course explores contemporary issues as a vehicle for teaching communication, and in particular works in some depth on environmental issues. The topics vary from semester to semester, but the emphasis is on the responsibility of an engineer to understand and mitigate the influence of technology on the environment.

- CMPE 142 (as an example) – This course provides examples of the influence of technological change on the design of software – specifically, operating systems.

- CMPE 195A & B – This course sequence prepares students for team-based design projects. As part of the course the students attend weekly technical workshops and seminars for contemporary engineering, science and technology topics, conducting library research and gathering data about the project topic for CmpE 195B. CmpE 195B, on the other hand, executes the conceptual design completed in 195A into an actual product. Students document the details of their design in a written report which is accompanied by an oral demonstration and presentation of the final product.

<table>
<thead>
<tr>
<th>Major courses: Specific contributions to the outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course</strong></td>
</tr>
</tbody>
</table>

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Engr 100W  To understand contemporary issues.

Cmpe 131  To provide basic knowledge in software engineering, contemporary software engineering techniques and tools in solving software engineering problems through supervised labs and homework projects.

Cmpe 142  To understand the principles and structures of modern computer operating systems.
To be familiar with processes and threads and their roles in program execution.
To study latest algorithms for scheduling and synchronizing processes and threads, and recognize and solve deadlock problems
To investigate and compare different approaches to main memory management.
To survey different modern techniques and technologies for file systems and data storage.
To practice skills implementing the concepts, structures, and algorithms using the C++ programming language.

Cmpe 195A & B  To understand and recognize contemporary challenges and long-term trends and directions in technology, science and economic development.

### Examples of assignments related to the outcome

The following is an example of exam questions, lab assignments and/or documentation deliverables at the different content levels that the students must complete and that contribute to their progression towards achievement of program outcome j. These examples target a students’ ability to project current trends into the future, and tests their understanding of at least one contemporary issue of professional importance.

ENGR 100W – Students are required to understand the impact of engineering solutions in an environmental context. Students from teams are required to do research on various environmental topics and have to find information on current research and technologies in very specific applications. Some recent topics assigned to students were “Landfill Gas Recovery Proposal”, “Hydrogen Powered Vehicle Research and it’s Future Challenges”, and “Designer Plants for the Environment”.

CMPE 195B – The students were required to

Write an individual professional plan

The plan should address: (1) Where do you expect to be professionally in five years? (2) How do you expect to get there? (3) How does the globalization (and in particular outsourcing) of your profession influence your plan? (4) What are the risks, and how are they addressed?

### Conclusion

Understanding the contemporary context in which the students work and live, and to be able to see trends and directions of society and the profession are valuable qualities in a computer engineering professional. The employer survey indicates a rating of 2.6, and the national exit study indicates that our students are significantly more confident than the graduates of peer programs in this area. The junior and senior surveys indicate an acceptable level of confidence across their last year.

The employer survey is a tad lower than we would like it to be (though it is still in the acceptable range), and is at some variance with the recent graduates’ expressed confidence in this area. The discrepancy may simply be a matter of the employers seeing graduates of previous years before the changes in the senior year curriculum were implemented. Though satisfactorily achieved, we will be watching outcome j to assess the improvements resulting from recent curriculum changes.

### B.6.1.8.11 Program Outcome k

“An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice” A computer engineering graduate must be able to use and to improve their mastery of the appropriate hardware tools and the software and hardware development environments and appropriate tools for the various aspects of computer engineering design and development. The students’ mastery of tools and techniques should also include an understanding of the use of the appropriate tools for validation, verification and testing of designs and other artifacts, e.g., to be able to collect engineering data using modern instruments.

The program utilizes software design and simulation tools that the students will be using in industry after graduation. In order to provide students with a broad learning experience, the program provides 18 laboratories equipped with tools of multiple disciplines (hardware, software), multiple platforms (Windows,
Unix), multiple levels from the very microscopic to the enterprise level (oscilloscope, Cadence Design; Visual C++, IBM Rational Rose), and multiple vendors (Apple, IBM, Xilinx, Cisco).

In the software part of the curriculum students learn to use Visual Studio for C++ design and implementation in a Windows environment to gain basic programming skills in the introductory software courses (CMPE 46 and CMPE 126). Students learn to use the GNU Suite of Unix environment tools for the intermediate and advanced courses — file processing (CMPE 130), operating systems (CMPE 142), and compiler design (CMPE 152). Students also are required to use IBM’s Rational Rose and the Rational Unified Process when modeling for the software engineering course (CMPE 131).

On the hardware side, after learning how to use basic laboratory instruments (oscilloscope, DMM, frequency counter, function generator, power supply, and capacitance meter) to build simple circuits in an introductory electrical engineering laboratory course (EE 97), students learn to use a variety of lab instruments and computer tools in their junior year. In digital laboratories (CMPE 124 and CMPE 125), students are using logic and computer design tools such as Xilinx Design Tools for simulation and design of logic and FPGA systems, Debug, and HDL.

Cadence and Xilinx design tools are being utilized in both CMPE 127 and CMPE 140 to give the students an opportunity to design current mirrors as a transition between discrete and integrated circuit design.

When they work on their senior design projects (CMPE 195A & B), students are required to identify which tools are appropriate for their project and to put them to proper use when completing the project.

The progression through the course contributions to outcome k is

**Engineering Core Courses**

- ENGR 10 – Using simple tools such as MATLAB and Excel to formulate and solve engineering problems.
- CMPE 46 & CMPE 101 – Engage students in using an integrated development tool (Visual Studio C++) to write and test simple software programs.
- EE 97 – Provide basic techniques and teach the students the use of modern engineering tools (such as oscilloscopes DMM, and function generators) for addressing hardware problems and conduct experiments in labs.
- ME 20 – Use AutoCAD for lab projects.

**Degree Required Courses**

- CMPE 102 – In this course the students are confronted with the limitations of compilers, and are made able to assess when it is appropriate to engage in crafted code development.
- CMPE 110, CMPE 124 – Use logic gate chipsets, breadboards and Cadence design tools for analyzing and solving digital and analog circuit and logic gate issues in lab projects
- CMPE 126 – Make more advanced use of the Windows Visual Studio software development environment. Understand and be able to apply abstract data structures and predefined libraries in software design and development.
- CMPE 152 – To make use of the GNU Suite of software development tools, and to be able to define problems in terms that allow the use of off-the-shelf tools for parsing and lexical analysis.
- CMPE 131 – To understand the simpler UML formalisms used to capture requirements specifications and design decisions. Make use of a subset of the IBM Rational Enterprise Suite (specifically, Rose).
- CMPE 125, CMPE 127, CMPE 140 – Provide capability to understand and design digital and computer hardware systems. Enhance capability to analyze problems, techniques and skill builders, and develop applications tools for microprocessors and computer systems. Make use of languages and tools such as Verilog, the Cadence Design tools, Xilinx FPGA.
- ISE 130 – Understand the use of statistical techniques, processes, and tools to formulate and analyze engineering problems, and analyze, interpreting data obtained for experiments.
- CMPE 195A, CMPE 195B – Engage students applying basic knowledge of mathematics and engineering using variety of techniques and modern engineering tools in identifying, formulating, and solving real-life problems. Engage students in designing and conducting computer engineering related experiments and in analyzing data with the life-cycle through design projects synthesis and evaluation. Provide capability to design and conduct quality assurance experiments, as well as
to analyze and interpret the results of such experiments. Evaluate and use tools appropriate for the project at hand.

**Major courses: Specific contributions to the outcome**

<table>
<thead>
<tr>
<th>Course</th>
<th>Contributions to the outcome arising from the course learning objectives</th>
</tr>
</thead>
</table>
| ENGR 010     | To conduct design and analysis of fundamental engineering projects  
- Use MATLAB and spreadsheets for lab projects                                      |
| ME 020       | To perform engineering drawings  
- Use AutoCAD for lab projects                                                      |
| EE 097       | Provide basic techniques and teach the students of modern engineering tools for solving hardware problems and conduct experiments in labs  
- Use logic gate chipsets and breadboard for supervised lab projects                    |
| ISE 130      | To provide statistical knowledge and skills, statistical techniques, processes, and tools to formulate and analyze engineering problems, and analyze, interpreting data obtained for experiments. |
| CMPE 046     | To develop and test software programs.  
- Use Visual C++ for lab projects                                                      |
| CMPE 101     | To develop and test software programs.  
- Use Visual C++ for homework and project assignments                                    |
| CMPE 102     | To using 80x86 instructions, floating point, MASM directives, macros, structs, etc. to design, implement, debug and test assembler modules of a hundred lines or more.  
To interconnect C, C++ and assembler modules, and to appreciate the role and limitations of high-level compilers.  
- Use GNU for homework and project assignments                                             |
| CMPE 110     | To use design tools to develop techniques for custom circuit design  
- Use Cadence design tool for lab projects                                               |
| CMPE 124     | To get familiar with test equipment  
- Use logic gate chipsets and breadboard for lab projects                                  |
| CMPE 125     | To use hardware description language (HDL), industry-standard electronic design automation (EDA) tools and prototyping equipment to perform hands-on design, verification and testing tasks.  
- Use Xilinx FPGA for supervised lab projects                                               |
| CMPE 126     | To become familiar with standard abstract data types and data structures, including stacks, queues, and linked lists, trees, and graphs, and the use of each in the C++ programming language.  
- Use Visual C++ for homework and project assignments                                     |
| CMPE 127     | To acquire proficiency in the use of standard algorithmic techniques including recursion, hashing, searching, and sorting.  
- Use Visual C++ for homework and project assignments                                     |
| CMPE 131     | To learn and practice skills using high-level software development tools, including compilers, linkers, source-level debuggers, and integrated software developments  
- Use Visual C++ for homework and project assignments                                       |
| CMPE 140     | To conduct system performance evaluation, calculate timing requirement and implement timing and reset circuit to the Microprocessor System.  
- Use chipsets in the form of programmable CPU and peripherals, p interrupt controllers for lab projects |
| CMPE 131     | To engage in object analysis and design project  
- Use IBM Rational Rose and MS Project for lab projects                                     |
| CMPE 140     | To use modern engineering tools for designing and verifying RISC CPUs  
- Use Cadence design suite and Verilog for lab projects                                    |
CMPE 152
To gain working skills in theory and application of finite state machines, recursive descent, production rules, parsing, and language semantics
- Use GNU for lab projects

CMPE 195A
To use current computer hardware/software design and analysis tools and technologies to work on the given senior projects
- Use all hardware and software tools provided by the curriculum

Examples of assignments related to the outcome
The following are examples of exam questions, lab assignments and/or documentation deliverables at the different content levels that the students must complete and that contribute to their progression towards achievement of program outcome k. These examples target a student’s ability to use engineering techniques and tools necessary for engineering practices.
CMPE 046 – In all lab assignments students are required to use the Microsoft Visual Studios development environment to write and test their assignments. They must become familiar with how to using the environment to create projects, include source and header files in a project, compile the project and interpret message errors when debugging their code. The following is a write-up of part of the first assignment used to familiarize the students with error messages they will encounter:

The purpose of this exercise is to produce a catalog of typical syntax errors and error messages that will be encountered by a beginner, and to continue to acquaint the student with the programming environment. This exercise should leave the student with knowledge of what error to look for when given any of a number of common error messages.
Your instructor will have a program for you to use for this exercise. You are to deliberately introduce errors to the program, compile and record the error message (if any), give explanation of error, fix the error, compile again (to make sure you have the program corrected), then introduce another error. Familiarize yourself with the error messages and the cause to be used in debugging for future assignments.
The sequence of suggested errors to introduce is:

a. Put an extra space between < and the iostream file name in the include directive.
b. Omit one of the < or > symbols in the include directive.
c. Omit the int from int main().
d. Omit or misspell the word main.
e. Omit one of the (), then omit both the () in main().
f. Deliberately misspell identifiers (i.e. cout, cin).

CMPE 125 – For major project assignment, students must use a given design approach and set of tools to create a prototype of a mini router that can identify the IP class of an incoming IP address and send out the corresponding prefix and suffix (or multicasting address). The data path of the mini router should be based on a generic DP with a register file, an input MUX, an ALU, a shifter, and input/output FIFOs. The control unit should be a hard-wired FSM. Performance should be a major goal of your design. Requirements: 1) Design approach – follow system-level design methodology taught in class; 2) Use of EDA tools – ModelSim Verilog HDL for design entry and verification, Synopsys FPGA Express for synthesis, Xilinx ISE for FPGA placement and routing; 3) Prototyping – demo required on the Digilent FPGA board.

CMPE 140 – For a lab assignment, students were asked to use the NC Verilog in the Cadence design environment to design and test a base band interleaver using two memory blocks that revitalizes faded data in a wireless system. The following is a write-up of the assignment:
Design an interleaver using two 8x8 memory blocks. The algorithm for interleaving uses three steps. In the first step, the incoming data is written row-wise into the first memory block. In the second step, the data is read out row-wise from the first memory and written column-wise into the second memory. In the last step, the data is read out row-wise from the second memory to the rest
of the base band receiver. In the later stages of the receiver, this data is processed to re-construct the transmitted data faded during the transmission.

The following steps should be applied to achieve the design:

1) Construct an architecture that contains two 8x8 memory units, data-path and a controller.
2) Construct the timing diagram of the data-path.
3) Generate the control signals that are necessary for the normal flow of data for interleaving.
4) Implement each module in this architecture using NC Verilog in Cadence design environment.
5) Perform functional verification on each implemented module. This task involves generating a test bench using NC Verilog, applying the test bench to the implemented components, and comparing the outputs produced from the module with the expected results. The result of this analysis may result in re-implementing one or more components.
6) Once the component level design and analysis is finished, connect the components according to the architectural schematic created in step 1 to create the interleaver.
7) Now, create a system level test bench using NC Verilog. Apply the test bench to the interleaver, analyze the outputs of this unit with the expected outputs at each clock cycle. This may require re-implementing the architecture by employing additional hardware blocks, altering the bus connections in the data-path or the state diagram of the control unit.
8) Include component level, system level schematics, test bench inputs and outputs, timing diagrams in your report.

Conclusion

The computer engineering curriculum is designed to enable the graduate to achieve outcome-k through a series of hardware/software laboratory, homework and project components. Our program provides students an iterative and incremental learning experience in conducting their laboratory/project assignments, using contemporary and professional tools as appropriate. The employer survey indicates a rating of 2.6, and the national exit study indicates that our students are significantly more confident than the graduates of peer programs in this area. The junior and senior surveys indicate a solid level of confidence across their last year. The alumni survey provides evidence that 93% of the respondents are using contemporary tools in their professional work.

The employer survey is a tad lower than we would like it to be (though it is still in the acceptable range), and is at some variance with the recent graduates’ expressed confidence in this area. The discrepancy may simply be a matter of the employers seeing graduates of previous years before the recent series of laboratory and course upgrades were implemented.

We feel that outcome k is well covered by the program.

B.6.2 MS in CMPE Program

B.6.2.1 Assessment Summary and Recommendations

<table>
<thead>
<tr>
<th>Course</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPE 200</td>
<td>I</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>CMPE 220</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td></td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>CMPE 294</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CMPE 295A, B</td>
<td>A</td>
<td>A</td>
<td></td>
<td></td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Student survey</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Advisory council</td>
<td>A</td>
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<td>A</td>
<td>U</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Alumni survey</td>
<td>A</td>
<td>A</td>
<td>I</td>
<td>U</td>
<td>A</td>
<td>I</td>
</tr>
<tr>
<td>Employer survey</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>U</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Overall Result</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>U</td>
<td>A</td>
<td>I</td>
</tr>
</tbody>
</table>
A: Achieved; I: To be Improved, U: Covered but not assessed

**Program Outcome I** *(Be able to demonstrate an understanding of advanced knowledge of the practice of computer or software engineering, from vision to analysis, design, validation and deployment)*

- Analysis: Student capability is assessed as “Achieved”.
- Recommendations:
  - No immediate actions required.
  - Recommendations CMPE 200 are provided in B.6.2.2.

**Program Outcome II** *(Be able to tackle complex engineering problems and tasks, using contemporary engineering principles, methodologies and tools)*

- Analysis: Student capability is assessed as “Achieved”.
- Recommendations:
  - No immediate actions required.
  - Recommendations to improve CMPE 200 are provided in B.6.2.2

**Program Outcome III** *(Be able to demonstrate leadership and the ability to participate in teamwork in an environment with different disciplines of engineering, science and business)*

- Analysis: Student capability is assessed as “Achieved”.
- Recommendations: No immediate actions required.

**Program Outcome IV** *(Be aware of ethical, economic and environmental implications of their work, as appropriate)*

- Analysis: Student capability is assessed as “Covered but not assessed”. It was not assessed by Advisory Council Inputs, Alumni Survey, or Employer Survey.
- Recommendations: redesign survey questionnaires to acquire feedbacks from stakeholders.

**Program Outcome V** *(Be able to advance successfully in the engineering profession, and sustain a process of life-long learning in engineer or other professional areas)*

- Analysis: Student capability is assessed as “Achieved”.
- Recommendations: No immediate actions required.

**Program Outcome VI** *(Be able to communicate effectively, in both oral and written forms)*

- Analysis: Student capability is assessed as “To be improved”.
- Recommendations:
  - Initiate assessment for CMPE 294 in Spring 2007
  - Recommendation to improve CMPE 295A and B are provided in B.6.2.2

### B.6.2.2 Course Assessment and recommendations

**CMPE 200**

For each learning performance indicator, the average value of assessment data contributes to one or more course learning objectives.

<table>
<thead>
<tr>
<th>Course Learning Objectives</th>
<th>Learning Performance Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Midterm Exam</td>
</tr>
</tbody>
</table>

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For each course learning objective, we apply equal weights to team project and final exam. 80% is used as the threshold of assessing whether an objective is “achieved” or “to be improved”.

<table>
<thead>
<tr>
<th>Course Learning Objective</th>
<th>Assessment Data</th>
<th>Student Learning Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Midterm Exam</td>
<td>Final Exam</td>
</tr>
<tr>
<td>200.1</td>
<td>9 (53.0%)</td>
<td>11 (64.7%)</td>
</tr>
<tr>
<td>200.2</td>
<td>9 (53.0%)</td>
<td>11 (64.7%)</td>
</tr>
<tr>
<td>200.3</td>
<td>3 (17.6%)</td>
<td>4 (23.5%)</td>
</tr>
</tbody>
</table>

A: Achieved, I: To be improved

Student learning capabilities of all course learning objectives have to be improved. Hence, CMPE 200 does not contribute to achieve program outcomes 1, 2, and 6.

67.3% of the students in the course did not pass. It is estimated (by observation) that almost all of the failing students received their undergraduate degrees overseas. The results of midterm 1 indicate that only about 30% of the students were adequately prepared to take this course, which is very nearly the same as the number of students who succeeded in passing the course. Furthermore, hardly any of the failing students were willing to believe that their poor performance in intermediate results during the semester demonstrated any lack of preparation on their part.

Given the difficulty of assessing undergraduate programs in other countries, it is recommended that we follow the example of many other graduate programs and require students to pass a qualifying examination before being admitted to graduate courses. The contents of the qualifying examination should include CMPE 124 and CMPE 127 as prerequisites in addition to CMPE 140.

The data analysis shows that the passing students succeeded in mastering the learning objectives in the simulation project. However, they need additional lecture time allocated to theory and analysis, as measured in examinations, particularly for 200.3.

If the need to devote a significant portion of the available lecture time to review were removed, this would provide ample time for extended coverage of these topics.

CMPE 220

<table>
<thead>
<tr>
<th>Exam Questions/Project/Special Topic</th>
<th>Assessment Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm Q1</td>
<td>71.0%</td>
</tr>
<tr>
<td>Midterm Q2</td>
<td>83.9%</td>
</tr>
<tr>
<td>Midterm Q3</td>
<td>67.7%</td>
</tr>
<tr>
<td>Final Q1</td>
<td>74.2%</td>
</tr>
<tr>
<td>Final Q2</td>
<td>80.6%</td>
</tr>
<tr>
<td>Final Q3</td>
<td>67.7%</td>
</tr>
<tr>
<td>Final Q4</td>
<td>80.6%</td>
</tr>
<tr>
<td>Homework</td>
<td>80.6%</td>
</tr>
<tr>
<td>Project</td>
<td>100%</td>
</tr>
<tr>
<td>Special Topic Report</td>
<td>100%</td>
</tr>
</tbody>
</table>
Based on the assessment of the scores of Question 3 in the midterm exam, loader and linker concepts used in assembly with multiple control sections were re-iterated in the class to provide the class with a clear understanding. In the Fall 2006 class, additional attention and focus will be put on the topic.

After reviewing the special topic reports turned in by students, their efforts in the area of experiment and analysis need to be improved. Some of the reports did not have sufficient testing or simulation results to validate design. The analysis work was not enough and structured. Some important perspectives were missed sometimes. The area will be emphasized in the class in the Fall 2006 semester. Some methods for performing robust analysis will be suggested to the class.

**CMPE 295A/B**

For Spring 2006, 31 students enrolled in CMPE 295A. Among these students, A:19, A-: 7, B+: 1, I:4. For Spring 2006, 31 students enrolled in CMPE 295B. Among these students, A+: 2, A:14, A-: 7, B: 1, I: 7. Twenty one (21) data points are available for analysis.

The following shows the average rating assigned to students across all projects by the advisors:

<table>
<thead>
<tr>
<th>Question from Worksheet</th>
<th>Average rating (0-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1. How do you rate the student’s knowledge of computer/software engineering?</td>
<td>4.8</td>
</tr>
<tr>
<td>Q2. How do you rate the student’s ability to use analysis, design and validation in problem solving?</td>
<td>4.7</td>
</tr>
<tr>
<td>Q3. How do you rate the student’s ability to solve complex problems and apply engineering/scientific principals to the solution of the problems?</td>
<td>4.6</td>
</tr>
<tr>
<td>Q4. How do you rate the student’s ability to use tools in the solution of complex engineering problems?</td>
<td>4.8</td>
</tr>
<tr>
<td>Q5. How do you rate the student’s ability to deliver an effective oral presentation?</td>
<td>4.3</td>
</tr>
<tr>
<td>Q6. How do you rate the student’s ability to effectively communicate in writing?</td>
<td>4.1</td>
</tr>
</tbody>
</table>

Based on the data, most of advisor think students needs to improve oral presentation (Q5) and written communication (Q6) skills. Thus Student Learning Outcome 6 (be able to communicate effectively, in both oral and written forms) should be improved.

It is recommended to improve oral and written communication skills through CMPE 294.
B. PROGRAM PLANNING REVIEW REPORT

Recommend to add additional oral presentations and strengthen the report writing requirements.

B.6.3 BS in SE Program

The BS SE program is still in its infancy – effectively having students enrolled in the program only for a few years, and with relatively low enrollment numbers – is still in a mode dominated by adaptation to circumstances. The program does not have any native graduates yet (only transfer students from other programs into the new BS SE program).

Assessment so far has focused on the role of the two courses “Software Design Studio I” and “Software Design Studio II,” and the degree of coordination required between these courses and the capstone experience.

Based on the assessment, the curriculum has been changed, replacing these courses with SE 187 (QA and testing) and SE 137 (Wireless Software Engineering). The rationale for the change was (1) that the degree of faculty coordination required for the successful deployment of the software design studio classes was unrealistic with the current enrollment numbers, (2) that the curriculum required a stronger support for the role of QA in the software development processes, and (3) that the particulars of embedded systems (and especially of embedded wireless systems) warranted a stronger presence within the curriculum.

B.6.4 MS in SE Program

B.6.4.1 Assessment Summary and Recommendations

<table>
<thead>
<tr>
<th>Course</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPE 202</td>
<td>A</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>CMPE 203</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td></td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>CMPE 294</td>
<td></td>
<td></td>
<td>U</td>
<td>U</td>
<td>U</td>
<td></td>
</tr>
<tr>
<td>CMPE 295A, B</td>
<td>A</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Student survey</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Advisory council</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>U</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Alumni survey</td>
<td>A</td>
<td>A</td>
<td>I</td>
<td>U</td>
<td>A</td>
<td>I</td>
</tr>
<tr>
<td>Employer survey</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>U</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Overall Result</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>U</td>
<td>A</td>
<td>I</td>
</tr>
</tbody>
</table>

A: Achieve, I: To be improved, U: Covered but not assessed

Program Outcome I (Be able to demonstrate an understanding of advanced knowledge of the practice of computer or software engineering, from vision to analysis, design, validation and deployment)

- Analysis: Student capability is assessed as “Achieved”.
- Recommendations: No immediate actions required.

Program Outcome II (Be able to tackle complex engineering problems and tasks, using contemporary engineering principles, methodologies and tools)

- Analysis: Student capability is assessed as “Achieved”.
- Recommendations: No immediate actions required.

Program Outcome III (Be able to demonstrate leadership and the ability to participate in teamwork in an environment with different disciplines of engineering, science and business)

- Analysis: Student capability is assessed as “Achieved”.
- Recommendations: No immediate actions required.
**Program Outcome IV** *(Be aware of ethical, economic and environmental implications of their work, as appropriate)*

- Analysis: Student capability is assessed as “Covered but not assessed”. It was not assessed by Advisory Council Inputs, Alumni Survey, or Employer Survey.
- Recommendations: redesign survey questionnaires to acquire feedbacks from stakeholders.

**Program Outcome V** *(Be able to advance successfully in the engineering profession, and sustain a process of life-long learning in engineer or other professional areas)*

- Analysis: Student capability is assessed as “Achieved”.
- Recommendations: No immediate actions required.

**Program Outcome VI** *(Be able to communicate effectively, in both oral and written forms)*

- Analysis: Student capability is assessed as “To be improved”.
- Recommendations:
  - Initiate assessment for CMPE 294 in Spring 2007
  - Recommendation to improve CMPE 295A and B are provided in B.6.4.2

### B.6.4.2 Course Assessment and recommendations

**CMPE 202**

For each learning performance indicator, the average value of assessment data contributes to one or more course learning objectives.

<table>
<thead>
<tr>
<th>Course Learning Objective</th>
<th>Assessment Data</th>
<th>Project</th>
<th>Final Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>C1</td>
<td>C2</td>
</tr>
<tr>
<td>202.1</td>
<td></td>
<td>93%</td>
<td>73%</td>
</tr>
<tr>
<td>202.2</td>
<td></td>
<td>82%</td>
<td>71%</td>
</tr>
<tr>
<td>202.3</td>
<td></td>
<td>93%</td>
<td></td>
</tr>
</tbody>
</table>

For each course learning objective, we apply equal weights to team project and final exam. 80% is used as the threshold of assessing whether an objective is “achieved” or ‘to be improved’.

- **A**: Achieve, **I**: To be improved, **U**: Covered but not assessed

<table>
<thead>
<tr>
<th>Course Learning Objective</th>
<th>Consolidated Assessment Data</th>
<th>Student Learning Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Project</td>
<td>Final Exam</td>
</tr>
<tr>
<td>202.1</td>
<td>93%</td>
<td>73%</td>
</tr>
<tr>
<td>202.2</td>
<td>82%</td>
<td>65%</td>
</tr>
<tr>
<td>202.3</td>
<td>93%</td>
<td>77%</td>
</tr>
</tbody>
</table>

Student learning capabilities of course learning objectives 202.1 and 202.3 are achieved. Hence, CMPE 202 contributes to achieve program outcomes I, II, and VI.

We need to improve the students’ learning capability of course learning objectives 202.2 – to be able to perform software development tasks from a system’s point of view.
After revisited students’ team projects and final exams, following actions are recommended and scheduled to be implemented in fall 2006:

1. Ensure students have adequate prerequisite of object-oriented programming.
2. Strengthen the contents of construction phase with design patterns and refactorings.

### CMPE 203

<table>
<thead>
<tr>
<th>Course Learning Objectives</th>
<th>Assessment Data</th>
<th>Student Learning Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Midterm Exam</td>
<td>Final Exam</td>
</tr>
<tr>
<td></td>
<td>Sec 1</td>
<td>Sec 2</td>
</tr>
<tr>
<td>203.1</td>
<td>86, 94, 85</td>
<td>94, 90</td>
</tr>
<tr>
<td>203.2</td>
<td>86, 94, 85</td>
<td>94, 90</td>
</tr>
<tr>
<td>203.3</td>
<td>86, 94, 97, 98</td>
<td>94, 90, 75, 85</td>
</tr>
<tr>
<td>203.4</td>
<td>94</td>
<td>75, 85</td>
</tr>
<tr>
<td>203.5</td>
<td>86</td>
<td>94</td>
</tr>
<tr>
<td>203.6</td>
<td>86</td>
<td>94</td>
</tr>
<tr>
<td>203.7</td>
<td>94</td>
<td>90, 74</td>
</tr>
<tr>
<td>203.8</td>
<td>86, 85</td>
<td>88</td>
</tr>
<tr>
<td>203.9</td>
<td>97</td>
<td>75</td>
</tr>
<tr>
<td>203.10</td>
<td>85, 98</td>
<td>94, 90</td>
</tr>
</tbody>
</table>

Midterm results for questions 3 and 5 in section 2 resulted in a review session following the Spring break. In addition a greater effort was made to generate more in class discussion the topic. Prior to the midterm discussion in section 2 was mainly carried on by only a few students. Following the midterm greater emphasis was place on getting complete class participation.

### CMPE 295A/B

Data was collected for 31 projects done by 49 students in Spring 2006. Projects size was 1 – 3 students. The projects were supervised by 15 faculty. Individual faculty supervised as many six projects and a few as a single project.

The following shows the average rating assigned to students across all projects by the 15 advisors:

<table>
<thead>
<tr>
<th>Question from Worksheet</th>
<th>Average rating (0-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1. How do you rate the student’s knowledge of computer/software engineering?</td>
<td>4.4</td>
</tr>
<tr>
<td>Q2. How do you rate the student’s ability to use analysis, design and validation in problem solving?</td>
<td>4.5</td>
</tr>
<tr>
<td>Q3. How do you rate the student’s ability to solve complex problems and apply engineering/scientific principals to the solution of the problems?</td>
<td>4.4</td>
</tr>
<tr>
<td>Q4. How do you rate the student’s ability to use tools in the solution of complex engineering problems?</td>
<td>4.6</td>
</tr>
<tr>
<td>Q5. How do you rate the student’s ability to deliver an effective oral presentation?</td>
<td>4.2</td>
</tr>
<tr>
<td>Q6. How do you rate the student’s ability to effectively communicate in writing?</td>
<td>4.1</td>
</tr>
</tbody>
</table>
The data collected is consistent with data collected from Fall 2005 in that it shows that students are perceived to be relatively weak in communication skills (Questions 5 and 6) compared to their technical skills (Questions 1-4).

It is recommended that a more collaborative skill delivery be made between students taking CMPE 295A and 295B and the writing classes that are offered (such as CMPE 294 and ENGR 200W). It is recommended that ENGR 200W be deemphasized for Software and Computer Engineering students and that CMPE 294 be the required writing class. This will make the logistics simpler for offering joint CMPE 295A and CMPE 294 classes.
B.7 Faculty

The Computer Engineering Program has 16 full-time faculty members (15 tenure track) involved in undergraduate teaching. The faculty members have on average served 8.6 years at SJSU and overall the average is 11.1 years as a faculty member at this or other institutions.

Each of the full-time faculty members has earned a doctorate degree in computer engineering, electrical engineering, or computer science. The academic background and current expertise ranges from device physics and nanotechnology to large-scale software development, covering all the curricular areas of computer engineering.

With an average of 7.3 years industry experience, faculty members are able to provide the appropriate professional engineering context for the material being taught. The curriculum emphasizes the immediate application of concepts taught, and the faculty are well prepared to support this (PEO-II).

All full-time faculty members are required to maintain an association with students through advising and counseling – students are assigned a faculty member as their adviser, and this relationship endures through the student’s tenure (this is a recent adaptation – in the past this association might change over the years). SJSU is a “minority–majority” university, with a large proportion of the students being from first-generation college-bound background, often with English only as a second (or third) language. Being part of the “American dream-machine” of enabling upwards social mobility provide for great personal satisfaction for the faculty members as we enjoy facilitating the success of our students and graduates.

The faculty members themselves arrive from a diverse set of cultural, national and linguistic backgrounds, and are well equipped to work with a student body of equally wide-ranging experience.

All full-time faculty members are expected to contribute to the overall direction of the program, its development (including the generation of new courses), its implementation and its evaluation. This expectation is captured in the appointment letters at the time of hire, and reinforced through the collegial retention, tenure and promotion process.

Each semester the faculty members gather for a full day of reflection, planning and social bonding, and the department offers a number of social events each year for community building for the faculty members, the students and their family members.

All full-time faculty are members of professional societies. Licensure is not a common practice in the computer engineering profession (nor in the information technology sector more broadly). In addition to the full-time faculty, the department is able to capitalize on our location in Silicon Valley, and can draw upon a large pool of professional talent for part-time instruction and project supervision. Through their research, consulting, and participation in local societies, faculty members have established professional networks that are made available to students to assist them in obtaining internships, summer jobs, undergraduate research experiences and full-time jobs upon graduation.

The following material provides evidence of the above (available in the appendices or at the time of the campus visit):

- Faculty workload summary
- Faculty analysis
- Faculty vitae
- Interviews with faculty
- Interviews with students

B.8 Facilities

B.8.1 Teaching Classrooms
For the department’s classroom needs, the Engineering Building contains 15 lecture rooms shared by all engineering programs. The classroom capacities are listed in Table B.8.2.2. Overflow lecture sections are scheduled in other facilities on campus through the Academic Scheduling Office.

**Table B.8.2.2 Classroom Capacity**

<table>
<thead>
<tr>
<th>Room #</th>
<th>Capacity</th>
<th>Room #</th>
<th>Capacity</th>
<th>Room #</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>232</td>
<td>40</td>
<td>331</td>
<td>100</td>
<td>341</td>
<td>100</td>
</tr>
<tr>
<td>301</td>
<td>40</td>
<td>337</td>
<td>70</td>
<td>343</td>
<td>100</td>
</tr>
<tr>
<td>303</td>
<td>40</td>
<td>338</td>
<td>30</td>
<td>395</td>
<td>35</td>
</tr>
<tr>
<td>327</td>
<td>30</td>
<td>339</td>
<td>70</td>
<td>401</td>
<td>40</td>
</tr>
<tr>
<td>329</td>
<td>70</td>
<td>340</td>
<td>50</td>
<td>403</td>
<td>40</td>
</tr>
</tbody>
</table>

The College of Engineering also manages a 210-seat auditorium (E189), several meeting rooms (E247, E335, E285, E287), and an open study area on the third floor. The auditorium is regularly used for professional presentations, symposiums, and occasionally, for large class lectures and exams. The meeting rooms are used for faculty and staff meetings and events.

### B.8.2 Teaching Laboratories

The department has extensive laboratory and computing facilities available to students and faculty. The utilization and maintenance of the laboratories is under the oversight of the **Facilities Committee**. The committee is elected by the department faculty, and has the primary responsibility for recommending laboratory organizations, equipment upgrades and equipment deployment that serves the students’ needs optimally.

A comprehensive review of the laboratory equipment and usage in 2003-05 resulted in a significant reorganization of the laboratories, currently under way. The laboratories are continually upgraded, and the current equipment and deployment is displayed in Table B.8.2.1.

**Table B.8.2.1 Laboratory Equipment**

<table>
<thead>
<tr>
<th>Focus (Room)</th>
<th>Funding Sources</th>
<th>Primary Equipment</th>
<th>Primary Software</th>
<th>Used by Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microprocessor Design (E268)</td>
<td>State</td>
<td>20 Workstations: Tektronix oscilloscopes DC power supplies, EPROM programmers PC stations</td>
<td>Windows, Linux, Xilinx</td>
<td>CMPE 127, CMPE 195A, CMPE 195B</td>
</tr>
<tr>
<td>Advanced Programming (E486)</td>
<td>State</td>
<td>28 Sun Sparc Workstations, Printer</td>
<td>Solaris Unix, GNU development tools, MySQL, Perl, Java</td>
<td>CMPE 126, CMPE 130, CMPE 152</td>
</tr>
<tr>
<td>Internet Technology (E492)</td>
<td>Intel</td>
<td>25 PC Stations 2 servers Printer</td>
<td>Windows</td>
<td>CMPE 131, CMPE 196H, CMPE 195A, CMPE 195B</td>
</tr>
</tbody>
</table>
The university (and the department) is in the process of deploying a campus-wide wireless network, and requiring all students to acquire a laptop with sufficient capability to allow most of the software development work to be done on the students’ own computers. As a consequence the teaching becomes ever-more interactive and the barrier between lecture and laboratory work is significantly reduced in some of the courses.

The college’s Engineering Computing Systems group manages eight computer laboratories as listed in Table B.8.2.3. These laboratories are exclusively for College of Engineering students, faculty, and staff use. These computers are loaded with programs including Matlab, AutoCAD, Unigraphics, ProModel, Visual Studio, Minitab, Pspice, ProEngineer, C++ compiler, word processing, spreadsheet and web browser.
These labs primarily support engineering common courses such as programming and writing classes. The open laboratories (E390 and E305) are available five days a week on a walk-in basis. Wireless Internet access is available in the most of the Engineering Building.

<table>
<thead>
<tr>
<th>Room #</th>
<th>No. of PCs</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>E333</td>
<td>30</td>
<td>Engineering classes using multimedia presentation or cooperative learning</td>
</tr>
<tr>
<td>E390</td>
<td>25</td>
<td>Open Lab</td>
</tr>
<tr>
<td>E391</td>
<td>25</td>
<td>Engineering core writing and programming classes such as: E10, E100W, CMPE046, ME20, and ME30.</td>
</tr>
<tr>
<td>E392</td>
<td>25</td>
<td>Engineering core writing and programming classes such as: E10, E100W, CMPE046, ME20, and ME30.</td>
</tr>
<tr>
<td>E393</td>
<td>25</td>
<td>Engineering core writing and programming classes such as: E10, E100W, CMPE046, ME20, and ME30.</td>
</tr>
<tr>
<td>E394</td>
<td>25</td>
<td>Engineering core writing and programming classes such as: E10, E100W, CMPE046, ME20, and ME30.</td>
</tr>
<tr>
<td>E405</td>
<td>27</td>
<td>Open Lab</td>
</tr>
<tr>
<td>E407</td>
<td>25</td>
<td>Engineering core writing and programming classes such as: E10, E100W, CMPE046, ME20, and ME30.</td>
</tr>
</tbody>
</table>

Engineering students can also take advantage of the computer lab located in the Student Union (adjacent to the Engineering Building) and computing services in the King Library. The Student Union computer lab has one hundred computer stations managed by the Associated Students Computer Services Center. The lab supports major operating systems (Windows, Linux, and Macintosh) and provides DVD and CD burners, high-speed Internet access, and document scanning capability. The King Library provides the following computer resources to all SJSU students:

- Laptop checkout for students: 80 laptop computers and 20 tablet computers
- Four computer classrooms (4): 123 computers
- Reserve-a-computers with office software & Internet access: 208 computers
- Research information computers with Internet access: 51 computers
- Library catalog computers for quick look-up: 27 computers
- Personal laptop computer connections: 180 ports
B.9 Institutional Support and Financial Resources

B.9.1 Financial Resources

The primary financial resource for the college is the state-supplied general fund allocated by the university. The Dean of the College allocates the college’s general fund to each program, primarily based on the program’s student enrollment as measured by the number of its Full-Time Equivalent Students (FTES). The general fund supports the program’s basic operating needs: faculty and staff salaries, supplies and services, and equipment requisitions. The college also receives a significant amount of financial support from three major external sources: funds from Extended Studies, contracts and grants, and donations and gifts. Funding from these sources supports college-wide initiatives for faculty and student development.

B.9.1.1 General Fund

The university establishes the college’s general fund allocation. The university assigns a FTES (full-time equivalent students) target and a Student-Faculty Ratio (SFR) to each college. Historically, the College of Engineering has been assigned an SFR of approximately 17.5, which is considerably less than that assigned to the College of Humanities and the Arts, for example. This lower SFR assignment is in recognition of the fact that engineering programs, because of their heavy emphasis on laboratory and project work, require a lower SFR than those disciplines whose courses are taught almost entirely in lecture mode. The assigned FTES and SFR are translated into the number of Full-Time Equivalent Faculty (FTEF). The difference between the FTEF and the number of tenure-track faculty members determines the number of full-time equivalent non-tenure-track lecturers, whose average salary is budgeted at $45,708 per academic year. The total faculty salary allocation is the sum of the actual salaries of tenure-track faculty and the budgeted amount for full-time equivalent lecturers. In addition to the faculty salary allocation, the university allocates a higher percentage of funding for equipment requisitions and maintenance to the laboratory-based disciplines such as engineering.

The annual budget allocation for each program is made by the Dean of the College with assistance from the Associate Deans and the college’s budget analyst. For the most part, the allocation is made by formula, especially in the areas of supplies, services, and travel. The formulas are based on each program’s fraction of the college’s FTES. Travel allocations, however, are based on the number of tenure-track faculty in each program. The $45,708 funding for hiring a full-time equivalent lecturer is generally inadequate. However, this problem is mitigated by the fact that the college has been able to tap into a vast pool of practicing engineering professionals in Silicon Valley, who don’t rely on teaching as a primary source of income.

B.9.1.2 Funds from Extended Studies

Funds from Extended Studies are derived from two sources: Open University and Off-Campus programs. Through the Open University program, non-matriculated students may be permitted, on a space-available basis, to take a regular course being offered. The Off-Campus programs include degree programs offered on company sites and the Rose-Orchard site which is managed by the College of Business. The net revenue from the Extended Studies programs has been approximately $300K per year for the last several years. A portion of the net revenue is distributed to the academic programs which contribute to the teaching of the programs. The remaining funds are used for supporting activities that would otherwise not be funded. Examples are travel expenses for faculty to present papers at professional meetings, expenses for hiring and recruiting new faculty members, start-up packages for new faculty, and matching support for equipment grants.

B.9.1.3 Contracts and Grants

The college also derives support from the return on indirect charges collected by the San Jose State University Foundation in connection with contracts and grants. The funding distributed to the college, which is used to support research-related activities, is divided into three equal portions: one-third goes to the Dean, one-third to the principal investigator’s department, and one-third to a research account controlled by the principal investigator. Over the past five years the funds available to the Dean, departments, and principal investigators have been approximately $50K - $60K each per year. In addition, grants for supporting instructional materials and laboratory development typically include budgets for lab equipment or computers.
B.9.1.4 Donations and Gifts
The college receives significant donations and gifts from our industry partners and individual contributors. These contributions take the form of equipment donations and cash grants. For instance, the college received an average of $1.5 million in cash gifts per year over the last five years from friends, alumni, and Silicon Valley companies such as AMD, Applied Materials, Atmel, Cadence, Cisco, IBM, Intel, Lam Research, Lockheed Martin, Maxim Integrated Products, National Semiconductor, Rockwell Collins, Synopsys, and Xilinx. Major contributors of laboratory and instructional equipment are Agilent Technologies, Applied Materials, Atmel, Cadence, Cisco, HP, Intel, Novellus, and Xilinx. Another significant financial source for the college is the interest income generated from the college’s endowment funds. Currently, the college has endowment funds of about $7.3 million dollars that support faculty development and hiring, student scholarships, and student co-curricular programs.

B.9.2 Instructional Support
Funding from the general fund allocated to the academic programs is used primarily to support their basic needs. Such funding, however, is inadequate to provide the high-quality educational programs needed by our students. The additional support provided by the college to the departments is funded by the general fund held by the Dean at the college level, special funds provided by the university, and external financial resources described in the previous section. The additional support covers four main areas: endowed chairs and faculty development, student scholarships, student support and co-curricular programs, and technical support.

B.9.2.1 Endowed Chairs and Faculty Development
Acquiring teaching resources and supporting faculty development are a high priority in the College of Engineering. Currently, the college has two endowed chairs: the Pinson Chair, and the Charles W. Davidson Chair in Construction Management which is earmarked for the Department of Civil and Environmental Engineering. The goal of the Pinson Chair is to help programs to develop new curricular areas. For instance, in AY 1999/2001 Pinson Chair Tom Boag helped develop the microelectronics process engineering program in the Department of Chemical and Materials Engineering. In AY 2001/03 Anthony Chan with the Department of Electrical Engineering helped develop the network engineering program. For AY 2003/05, Russell Smith with the Department of Computer Engineering has assisted in the development of the Software Engineering program. These Pinson chairs have extensive industry experience which is critical in their developing new curriculum at the college. In the area of faculty development, the college provides sabbatical leave opportunity, reduced teaching load for new faculty members, and faculty development grants.

B.9.2.1.1 Sabbatical Leave
The purpose of sabbatical leave is to benefit the university, its students, and its programs through the professional development of the faculty. Sabbatical projects include scholarly and professional activities, activities which enhance a faculty member's pedagogical and professional competencies and projects which contribute significantly to the development of a discipline or curricular area. Faculty can either take a one-semester sabbatical with full pay or a two-semester sabbatical with half pay. The number of awards given to the engineering faculty is typically between three to five annually.

B.9.2.1.2 Reduced Teaching Load for New Faculty Members
It is the college’s policy to assist new faculty members to develop their teaching repertoires and initiate research programs by reducing their teaching loads by one-half during their first year and by one-quarter during their second year. This policy pertains to all faculty members newly hired as assistant professors. More experienced faculty members also receive some initial release-time support depending on their needs and qualifications. The college also has a 1:2 matching policy to provide assistance to faculty members who secure external grants to reduce their teaching loads. If a faculty member secures external funding sufficient to reduce his/her teaching load by two courses, the college provides a third course reduction.
B.9.2.1.3 Faculty Development Grants

Faculty development grants provide a way to advance the faculty’s career aspirations and the college’s objective of becoming a premier undergraduate engineering educational institution by recognizing, promoting, and supporting faculty’s research achievements and excellence in teaching. The research and teaching goals are mutually supportive with research providing vitality and vision in technical issues and teaching providing focus for research and a channel for dissemination of knowledge gained in research efforts. Since 2002, the college has offered the Engineering Research Development Grant and the Teaching Development Grant to the faculty of the College of Engineering. These two grant programs are entirely supported by external funding.

The Engineering Research Development Grant provides support to enable, to initiate, or to coordinate research efforts of the faculty members and their departments. Faculty members are encouraged to collaborate on project proposals and pursue team-oriented projects. The Engineering Teaching Development Grant is intended to support faculty efforts in curricular development, assessment, and improvement for subjects aligned with departmental priorities as well as enhancing students’ learning effectiveness. The funding level of both development grants has been about $90K per year with one course release time budgeted at $5K.

In addition to the college’s faculty development grants, the university offers two faculty grant programs: the CSU Research Grant and Professional Development Grant. The CSU Research Grant offers funding for “seed” money or summer fellowships. "Seed" money ($5K) is for testing promising ideas and obtaining preliminary results prior to seeking external support. “Seed” money can be used for research, clerical assistance, equipment, software, or travel which is essential to the project. Summer fellowships ($7,500) are awarded in whole-month increments to faculty members at their regular monthly rate of pay. The grants fund the time needed by the faculty to initiate, continue, or complete research projects. The funding level for engineering awards has been about $20K per year for the past five years.

The Professional Development Grant supports professional development for faculty, staff, and students. Categories for which funds may be used include participating in training/education programs, conferences, hiring student assistants, travel, software, equipment and supplies. Staff and student organizations are also eligible to apply. The total grant awards for engineering faculty have been about $36K per year for the past several years.

B.9.2.2 Student Scholarships

The college started the Silicon Valley Engineering Scholarship program in 2001 by offering scholarship awards to top incoming students. The funding is provided by Silicon Valley companies and individual supporters. In addition, the Silicon Valley Engineering Scholarship recipients have opportunities for summer internships with sponsoring companies. The sponsoring companies include Applied Materials, Atmel, Cadence, Lam Research, Lockheed Martin, National Semiconductor, Rockwell Collins, and Solectron. The typical scholarship award is $20K per student at $5K per year for a four-year period. There have been 25 scholarship recipients since 2001. In addition, the college, in collaboration with Hewlett-Packard Company, has an HP Scholar program targeting underrepresented minority engineering students. The HP Scholar program provides each student not only financial assistance, but also a support program of mentoring, advising, and internship.

B.9.2.3 Student Support and Co-Curricular Programs

The college, in collaboration with the departments, has provided student advising in the areas of general education and transfer evaluations. Further, special advising has been offered to underrepresented minority students and students on academic probation. Taking advantage of its location in Silicon Valley, the college has been proactive in developing co-curricular programs that complement students’ classroom learning.

B.9.2.3.1 Student Support

The College of Engineering funds two student advising and support units: the Engineering Student Advising Center and the MESA Engineering Program. The Engineering Advising Center, established in Spring 2005, provides general education advising, new student advising, and special advising for students on academic probation. The goal of the MESA Engineering Program is to increase the number of engineering graduates entering the engineering profession from groups with low eligibility rates in college admissions.
Engineering students can also take advantage of the services provided by the University Academic Services including free tutoring and various study skills workshops.

B.9.2.3.2 Co-Curricular Programs

Co-curricular programs have been an integral part of the educational experience that the college offers its students with the goal of providing opportunities to students to learn about the context and domain of current and future engineering practices. There are three on-going programs sponsored by the college: Co-op Project Course, Global Technology Initiative, and Silicon Valley Leaders Symposium.

Co-op Project Course (ENGR 197)

This course is designed to provide students practical work experience with innovative technology companies in Silicon Valley. Students are also taught to further their communication and interpersonal skills as practiced in a professional setting. This course is coordinated jointly by an engineering faculty member and an industry instructor, and is in collaboration with the University Career Center. The Career Center assists students in obtaining internship positions with local companies.

Global Technology Initiative (GTI)

With an increasingly global technical workforce, the college established the Global Technology Initiative (GTI) in 2004 with a goal of providing our students a global perspective. The focus is on technology and business developments in the Asia-Pacific region, which has strong links with Silicon Valley. The GTI is funded by a one-million-dollar endowment supported by industry leaders with strong ties to Silicon Valley and the Asia-Pacific area. Each year this funding supports about 25 students and three faculty members on a two-week all-expense-paid study-tour to Asia. For instance, in summer 2004, 25 engineering students and four faculty members visited a variety of technology enterprises as well as educational and research institutions in China and Taiwan. They witnessed first-hand the advancement of the high tech industry in that region and the high level of interconnectedness of Taiwan’s and China’s businesses with those in Silicon Valley. This study program also included significant components in pre-trip acculturation and post-trip dissemination of lessons learned. Assessments indicate that many students change their study and career plans because of their own trip experience or lessons learned from their classmates who went on the study tour.

Silicon Valley Leaders Symposium

Each Thursday the College invites an industry or technology leader to campus to speak on topics of importance to engineering faculty and students: emerging technologies, business practices, and industry trends. This is the College’s Silicon Valley Leaders Symposium. Further, the Symposium provides an opportunity for our faculty and students to interface with industry leaders and learn from their insights and experience. The following two tables list the speakers and their topics presented in Fall 2005 and Spring 2006 semesters.

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Title</th>
<th>Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>GTI Scholars</td>
<td>College of Engineering</td>
<td>2005 GTI Study Tour Reflection Part I</td>
</tr>
<tr>
<td></td>
<td>San Jose State University</td>
<td></td>
</tr>
<tr>
<td>Dr. Robert J. Perlmutter</td>
<td>Vice President and General Manager</td>
<td>Developing Leading Edge Inspection System for Semiconductor Industry</td>
</tr>
<tr>
<td></td>
<td>WIN Division KLA-Tencor</td>
<td></td>
</tr>
<tr>
<td>GTI Scholars</td>
<td>College of Engineering</td>
<td>2005 GTI Study Tour Reflection Part II</td>
</tr>
<tr>
<td></td>
<td>San Jose State University</td>
<td></td>
</tr>
<tr>
<td>Mr. Dave Purvis</td>
<td>Executive Vice President, Design and Engineering, Solectron</td>
<td>Engineering in a Global Economy</td>
</tr>
<tr>
<td>Dr. Robert Regusa</td>
<td>Senior Vice President of Global Operations, Affymetrix</td>
<td>Future Trends in Space Technology</td>
</tr>
<tr>
<td>Mr. Ric Telford</td>
<td>Vice President of Automatic Computing Architecture &amp; Technology</td>
<td>Automatic Computing: Moving Towards Self-Managing Systems</td>
</tr>
<tr>
<td>Speaker</td>
<td>Title</td>
<td>Presentation</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------</td>
</tr>
<tr>
<td>Dr. Stefan Lai, Fellow IEEE</td>
<td>Vice President of Technology and Manufacturing Group, Intel Corporation</td>
<td>TBA</td>
</tr>
<tr>
<td>Mr. Pat Cavaneyr</td>
<td>Senior Vice President of Operations and IT, Hewlett-Packard Company</td>
<td>HP’s Global Delivery Story: How, Where, When, Why, and Who</td>
</tr>
<tr>
<td>Dr. Steven F. Zornetzer</td>
<td>Deputy Director for Research NASA Ames Research Lab</td>
<td>Technology Challenges at NASA: Achieving the Exploration Vision</td>
</tr>
<tr>
<td>Dr. Sass Somekh</td>
<td>President, Novellus</td>
<td>The Role of Innovation and Leadership in Product and Business Development</td>
</tr>
</tbody>
</table>

**Spring 2006 Silicon Valley Leaders Symposium**

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Title</th>
<th>Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr. Tommy Lee</td>
<td>Vice President, NVIDIA</td>
<td>Engineering in High Velocity Collaborative Environment, a Globalization Challenge</td>
</tr>
<tr>
<td>Dr. Barry James Folsom</td>
<td>Corporate Vice President &amp; General Manager Motorola, Inc.</td>
<td>Seamless Home Mobility</td>
</tr>
<tr>
<td>Dr. Mark Dean</td>
<td>Vice President and IBM Fellow, IBM Almaden Research Center</td>
<td>Opportunities for Innovation in the IT Industry</td>
</tr>
<tr>
<td>Dr. Geoffery Westr</td>
<td>President of New Mexico</td>
<td>Size Matters; Growth, Innovation and the Pace of Life from Cells to Cities</td>
</tr>
<tr>
<td>Mr. Robert Murray</td>
<td>Vice President, Molecular Devices Corporation</td>
<td>Made in China, Designed in California: Does this Model Work for Product Innovators</td>
</tr>
<tr>
<td>Mr. Sandeep Vij</td>
<td>Vice President, Worldwide Marketing, Xilinx</td>
<td>Hi-Tech Marketing Demystified</td>
</tr>
<tr>
<td>Dr. John Hennessy</td>
<td>President Stanford University</td>
<td>The 21st Century University</td>
</tr>
<tr>
<td>Mr. Patrick Little</td>
<td>Vice President of Worldwide Sales &amp; Services, Xilinx</td>
<td></td>
</tr>
<tr>
<td>Mr. Bart Hughes</td>
<td>Partner accentures</td>
<td></td>
</tr>
<tr>
<td>Mr. Babak Hedayati</td>
<td>Senior Vice President, World Wide Marketing, Cypress Semiconductor Corporation</td>
<td>Career Panel</td>
</tr>
</tbody>
</table>

**B.9.2.4 Technical Support**

The college provides technical support to all its academic programs in two areas: computer/networking and machine shop. The computer/networking support is provided by the Engineering Computing System group and the Central Shop provides design and fabrication services.
B.9.3 Challenges
A continuing problem for the college is the generally low faculty salaries. On an absolute scale faculty salaries may not be unreasonably low, but because of the very high cost of housing in Santa Clara County, attracting and retaining high-quality faculty has become a great challenge. Administrators both at the university and CSU System Office have been made aware of this issue, but faculty compensation throughout the System is a contentious issue, so the particular difficulties of engineering and other high market-rate disciplines have not received the attention they require. The problem is compounded by the fact that the State of California experienced a deep recession in the past four years, which badly eroded support for the universities in the state. Against this background of deteriorating financial support from the state, the college has experienced an enrollment drop for the past two years in its two largest programs, Electrical Engineering and Computer Engineering programs. Since the funding from the university is based on FTES, reduced college’s FTES translate into a lower-level funding for the college.

In view of the inadequate state funding for the college to develop its programs, the college has been more aggressive in generating revenues from external sources for the past two years. For instance, the number of revenue-generating Off-Campus programs has increased from five to nine. The annual cash gifts of about $1.5 million dollars have increased. Nevertheless, the college has a potential for generating higher-level gifts if it has staffing support in fundraising. Recognizing such a need, the university recently hired a Development Officer to support the college’s fundraising efforts. This individual is assisting the Dean in formulating a development plan for the college to expand its industry partnerships and alumni support.
B.10 Interdependence of Programs

B.10.1 Service to the SJSU
One of the courses offered by the Computer Engineering department serves degrees outside the College of Engineering – CMPE/MUSE 014E Internet Privacy – is an offering to first-semester frosh in other departments, and uses internet security and privacy issues as a vehicle to introduce young people to the life of academic inquiry.

B.10.2 Service to Programs of College of Engineering
CMPE 046 is a service course for the BS EE and BS ISE degrees.

B.10.3 Service to the MSE Program
A significant number of MS Engineering students attend the MS SE/CMPE courses in networking, security and software design. These are all elective courses within the MS Engineering degree, and students are accommodated in line with the MS CMPE and MS SE students.

B.10.4 Service to the Off-Campus Programs
The department offers the MS SE degree off-campus to industry clients that wish to further their employees professional development through tailored MS degree programs offered on-site. The off-campus programs are identical in academic content to their on-campus counterparts, with the examples and projects being used as learning vehicles being tailored to the client’s specific needs.
C. PROGRAM PLANNING AND STRATEGIES

C.1 Strategies and Actions Plan

C.1.1 Goal 1 – Improve the quality of student learning

C.1.1.1 Objective 1 – Complete BS in SE assessment cycle in 2008
The Computer Engineering and the Computer Science departments are subject to different accreditation agencies with different success criteria and assessment traditions. The BS SE program is drawing heavily on the existing course offerings of these two departments. Coordinating the assessment processes so as to avoid duplication of effort and to maximize the efficiency of the improvement process is a significant challenge.

*Action* – Coordinate the assessment efforts and bring into harmony the assessment methodologies of the CS and the Computer Engineering Departments

*Responsibility:*
BS SE coordinator and the BS SE committee

*Resources:*
1 course release per year
1 one-day faculty retreat per year

*Timeline*
- Spring 2007: Collect stakeholder results
- Fall 2007: Faculty review
- Spring 2008: Implementation of resultant modifications

*Success Metric*
Phases 1, 2 and 3 being checked-off as completed.

C.1.1.2 Objective 2 – Focus support for the specializations of the programs

*Action* – Strengthen the strategic curriculum components of embedded systems, secure systems and services-oriented architectures

*Responsibility*
Department Chair
Faculty (the respective curriculum committees)

*Resources*
Three new tenure track faculty positions

*Timeline*
- Spring 2007: Complete hiring process for two positions (embedded systems, services-oriented architectures)
- AY 2007–08: Complete search for the third position (secure systems)
- AY 2007–08: Complete assessment and modification of the embedded systems curriculum of the MS CMPE degree

*Success Metric*
Three new tenure track positions filled
Embedded systems specialization of the MS CMPE degree defined and implemented
Secure systems specialization of the MS CMPE degree defined and implemented

C.1.1.3 Objective 3 – Coordinate offerings with and recruitment from community colleges

*Action* – Implement the California LDTP for the BS CMPE program

*Responsibility*
Faculty (undergraduate curriculum committee)

*Resources*
Permission to add an extra unit to the BS CMPE degree

*Timeline*
- Spring 2007: Define and get approval for the curriculum changes
- Fall 2008: Implement the new curriculum

*Success Metric*
A new curriculum in compliance with the LDTP is in place

**Action** – Reach out to the community colleges for student advising and recruitment

**Responsibility**
Faculty (recruitment committee)

**Resources**
Faculty motivation

**Timeline**
Every semester: Visit two-three community colleges

**Success Metric**
Number of transfer students entering the BS degrees from the community colleges visited

**C.1.1.3 Objective 4 – To implement the closer integration of the BS and MS degrees allowed by the change in CSU policy with respect to co-terminal degree programs.**

**Action** – Establish the administrative framework for the co-terminal degree programs

**Responsibility**
Chair and the undergraduate studies committee

**Resources**
None required at the department level

**Timeline**
Spring 2007: Work with the registrar’s office to identify the necessary modifications to the student registration system.
Fall 2007: Implement the system

**Success Metric**
Number of student enrolled in the co-terminal degree program.

**C.1.1.4 Objective 5 – Graduate students with a multicultural and global professional perspective**
The IT professions are profoundly global, and it is of crucial importance that our graduates be provided with a global perspective through direct experience of multicultural work environments.

**Action** – Establish a regular study-abroad offering for the department’s students

**Responsibility**
Chair and selected faculty members

**Resources**
One course release per year

**Timeline**
Spring 2007: Summer course offering preparation and recruitment

**Success Metric**
Number of courses offered abroad per summer.

**Action** – Be an international learning institution of choice

**Responsibility**
Chair, Graduate studies committee, graduate program directors

**Resources**
$5-10,000/year in support funds

**Timeline**
Recurring: Visit with select feeder institutions in other countries, establishing student pipelines and coordinated education offerings.

**Success Metric**
Number of international applicants
Minimum qualifications of the admitted applicants

**C.1.2 Goal 2: To continue to strengthen our broadly connected learning and research environment.**
Computer and software engineering are disciplines with applications directly affecting or supporting other engineering disciplines, as well as disciplines in the humanities, business and science. It
is also a very global discipline, interacting professionally and otherwise with the whole nation and the world.

C.1.2.1 Objective 1 – Develop curricular support for the interplay of computer and mechanical engineering

*Action* – Define and implement a new course in the software aspects of mechatronics

*Responsibility*
- Undergraduate studies committee and selected faculty members

*Resources*
- No extra resource required

*Timeline*
- Spring 2007: Define course in consultation with the MAE Department
- AY 2007–08: Offer the course

*Success Metric*
- One new course established and integrated into the BS ME program.

C.1.2.2 Objective 2 – Develop curricular support for educating the broader student population about the interplay of technology and policy

*Action* – Define and implement a new general education course in the security, privacy and public policy

*Responsibility*
- Undergraduate studies committee and selected faculty member

*Resources*
- One course release

*Timeline*
- Spring 2007: Define course
- AY 2007–08: Achieve BOGS approval
- AY 2008-09: Offer the course

*Success Metric*
- One new course established, offered and sufficiently attractive to be sustainable.
C.2 Five Year Faculty and Staff Hiring Plan

C.2.1 Faculty Hiring Plan and Justification

I. Curricular Responsibilities/Faculty Competencies

1. Identify current curricular responsibilities and the number of full-time equivalent faculty required for each.

2. Identify regular faculty currently performing these responsibilities, noting by year any requirements anticipated the next five years.

<table>
<thead>
<tr>
<th>Curricular Responsibilities</th>
<th>Equivalent Full-time Faculty</th>
<th>Names of Faculty</th>
<th>Retirement/Termination Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>System-on-Chip</td>
<td>1</td>
<td>BINDAL, Ahmet</td>
<td>&gt; 5 YEARS</td>
</tr>
<tr>
<td>Software systems</td>
<td>1</td>
<td>CHANG, Lee</td>
<td>&gt; 5 YEARS</td>
</tr>
<tr>
<td>Networks</td>
<td>1</td>
<td>FATOOHI, Rod</td>
<td>&gt; 5 YEARS</td>
</tr>
<tr>
<td>Software engineering</td>
<td>1</td>
<td>Recruit #1</td>
<td>Spring 2006</td>
</tr>
<tr>
<td>Software systems design</td>
<td>1</td>
<td>GAO, Jerry</td>
<td>&gt; 5 YEARS</td>
</tr>
<tr>
<td>Intelligent agents</td>
<td>1</td>
<td>HAMBABA, Ahmed</td>
<td>&gt; 5 YEARS</td>
</tr>
<tr>
<td>Digital design</td>
<td>1</td>
<td>HUNG, Donald</td>
<td>&gt; 5 YEARS</td>
</tr>
<tr>
<td>Multimedia systems</td>
<td>1</td>
<td>LI, Harry</td>
<td>&gt; 5 YEARS</td>
</tr>
<tr>
<td>Software architectures</td>
<td>1</td>
<td>MELDAL, Sigurd</td>
<td>&gt; 5 YEARS</td>
</tr>
<tr>
<td>Digital design</td>
<td>1</td>
<td>OZEMEK, Haluk</td>
<td>&gt; 5 YEARS</td>
</tr>
<tr>
<td>Software engineering</td>
<td>1</td>
<td>POUR, Gilda</td>
<td>&gt; 5 YEARS</td>
</tr>
<tr>
<td>Database systems</td>
<td>1</td>
<td>SHIM, Simon</td>
<td>&gt; 5 YEARS</td>
</tr>
<tr>
<td>Network quality of service</td>
<td>1</td>
<td>SU, Xiao</td>
<td>&gt; 5 YEARS</td>
</tr>
<tr>
<td>Intelligent systems</td>
<td>1</td>
<td>WESLEY, Len</td>
<td>&gt; 5 YEARS</td>
</tr>
<tr>
<td>Software quality processes</td>
<td>1</td>
<td>YU, Weider</td>
<td>&gt; 5 YEARS</td>
</tr>
<tr>
<td>Embedded systems</td>
<td>1</td>
<td>Recruit #2</td>
<td>Spring 2004</td>
</tr>
<tr>
<td>Secure systems</td>
<td>1</td>
<td>Recruit #3</td>
<td>Rollover from AY 2004-05</td>
</tr>
<tr>
<td>Software process management, deployment &amp; metrics</td>
<td>1</td>
<td>Recruit #4</td>
<td>2006</td>
</tr>
<tr>
<td>Computer firmware &amp; real-time systems</td>
<td>1</td>
<td>Recruit #5</td>
<td>2006</td>
</tr>
<tr>
<td>Network communications</td>
<td>1</td>
<td>Recruit #6</td>
<td>2006</td>
</tr>
</tbody>
</table>

II. Anticipated Needs

To allow flexibility for changes in course offerings and enrollments, the number of regular (tenure-track and tenured) faculty should be limited to a maximum of 80 percent of the equivalent of full-time faculty. Although FERP faculty need not be counted in calculating this percentage, they must be considered in deciding if 80 percent is a reasonable norm: assignments for all FERP faculty must be covered in departmental school allocations. All new participants in FERP represent faculty competencies that will need to be replaced after the four-year term in the program has expired.
1. Program that exceeds an 80 percent limitation may require a reassignment of regular faculty. If so, please indicate if such a situation exists and identify when and how retraining or reassignment may be accomplished.
   N/A

2. Identify those needs (other than replacement of regular faculty on leave) for which you expect to be hiring temporary faculty. (Remember that this category should be .200 FTE/F).

   Temporary faculty will still be needed in the Computer Engineering Department programs. The MS Software Engineering degree program and the BS Software Engineering program are staffed to a large extent by temporary faculty, and we expect that to continue.

3. Identify those specialization or responsibilities for which you anticipate making tenure-track requests and the year in which you anticipate recruitment at other than assistant professor rank must be accompanied by documentation of need for program or departmental/school leadership or of limited availability of candidates.

Requests will be forthcoming in future years. The Computer Engineering Department’s programs are among the largest in the University. The search is to refill one position in software engineering and one in embedded system.

   Aside from replacing the departing faculty member in software engineering, the department has identified two areas where we think it particularly prudent to strengthen our expertise: embedded systems and secure systems, both areas that have been identified by the department as being of strategic importance. The review of the new MS Software Engineering program (prior to its approval) also underscored the importance of embedded systems coverage.

   A third recruit (if we are allowed to extend the search to that) will be focusing on the secure systems area.

   The department is ramping up its capability to offer software engineering courses in support of the new BS and MS Software Engineering programs. At this point there is a need for instructors in practically all aspects of Software Engineering, with the possible exception of database systems and software testing. Consequently we find that a fairly open search is the most likely to secure candidates of acceptable caliber without there being a significant danger of unnecessarily duplicating existing expertise.

III. Annual Request and Program Review Documentation (if a five-year plan has been submitted previously, only this section is required. Enclose portion of most recent program review relevant to curricular development/faculty competencies).

1. Attach position announcements for those specialization for which you wish to conduct searches this year. Announcements must clearly identify those qualifications, which will constitute screening criteria and those responsibilities which appointees will be expected to perform.

2. a. Using the following formula, calculate the percentage of equivalent full-time faculty positions filled by tenure-track and tenured faculty if recruitment is successful:

   (1) Number of full-time tenured faculty
   (Do not count administrators with full-time assignments outside the department/school.) 10

   (2) Number of tenure-track faculty 3

   (3) Number of tenure-track searches extended 0

   (4) Number of tenure-track searches proposed 2

   (5) Present year allocation (in equivalent full-time positions) 23.1

Self-Study Report v8.doc
C. PROGRAM PLANNING AND STRATEGIES

(6) \[ \frac{(1) \text{ through } (4)}{(5)} \] divided by (5) \[ 0.65 \]

b. Identify other factors affecting actual or potential use of allocation.

(1) Number of faculty on Pre-Retirement or FERP \[ 0 \]
(2) Number of full-time administrators with retreat rights \[ 1 \]
(3) Number of faculty regularly teaching outside the department/school (note time fraction and department) \[ 0 \]
(4) Amount of administrative time and assigned time currently allocated to department chair/school director \[ 0.6 \]

3. Add supplementary information regarding the position request, including for example, revision to the five-year plan, additional documentation supporting a request to hire at an advanced level or above the 80 percent limitation, or particular expectations to be written into the appointment letter.

IV. Department Diversity Profile Overview / Tenured & Tenure-Track Faculty

1. Department Gender and Racial / Ethnic Breakdown, tenured and tenure-track faculty.

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>African American &amp; African</strong></td>
<td>1</td>
<td>0</td>
<td>7.1%</td>
</tr>
<tr>
<td><strong>Asian / Pacific Islander</strong> (Asian Indian, Cambodian, Chinese, Filipino, Guamanian / Chamorro, Hawaiian, Japanese, Korean, Laotian, Samoan, Vietnamese)</td>
<td>6</td>
<td>1</td>
<td>50.0%</td>
</tr>
<tr>
<td><strong>Hispanic</strong> (Cuban, Mexican / American, American / Chicano, Puerto Rican, Other Latin American origin)</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>American Indian / Alaskan Native</strong> (Original peoples of North America with cultural identification maintained through tribal affiliation or community recognition)</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>White</strong> (Original peoples of Europe, North Africa, or Middle East, not of Hispanic origin)</td>
<td>5</td>
<td>1</td>
<td>42.9%</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>12</strong></td>
<td><strong>2</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

2. Provide a brief overview of gender, racial / ethnic diversity of doctoral degree recipients (or other terminal degree recipients) in your discipline:

From the CRA’s Taulbee 2004-05 Survey covering the Computer Science and Engineering doctoral production for 2004-05:
The department is more broadly diverse than the norm for the US, both in terms of gender and in terms of ethnicity. There are, however, disturbing gender and ethnicity under-representation.

4. What are the outreach efforts the department will employ? 
The department is actively engaged in national research centers and other collaborative efforts involving HBSC and HSI institutions. These relationships as well as participation in conferences, workshops and other professional venues will be leveraged to ensure that the employment opportunities at SJSU are made known and available to traditionally underrepresented groups.
C.2.2 Staff Hiring Plan and Justification

With the large number of programs and students, and with the substantial number of laboratories, the department would be well served by adding one administrative staff person and two technology staff people.

However, in the absence of indicators that funding for such position would be forthcoming, the department has not made specific hiring plans for this strengthening of support.
Appendix I – Additional Program Information

A: Tabular Data for BS in CMPE Program ........................................................... I-2
   Table 1. Course and Section Size Summary ............................................. I-2
   Table 2. Faculty Workload Summary ..................................................... I-3
   Table 3. Faculty Analysis ....................................................................... I-5
   Table 4: Support Expenditures .............................................................. I-6
B: Sample Course Syllabi .............................................................................. I-7
C: Faculty Vitae ............................................................................................. I-70
# A: Tabular Data for BS in CMPE Program

## Table I-1 Course and Section Size Summary

BS in Computer Engineering

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Title</th>
<th>No. of Sections offered in Spring 2004</th>
<th>Average Section Enrollment</th>
<th>Percent Lecture, Lab, Recitation, Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lec  Lab</td>
<td>Lec  Lab</td>
<td>Lec  Lab</td>
</tr>
<tr>
<td>CmpE-046</td>
<td>Computer Engineering I</td>
<td>2 4</td>
<td>42 21</td>
<td>40% 60%</td>
</tr>
<tr>
<td>CmpE-101</td>
<td>Programming Concepts &amp; Problem Solving</td>
<td>1 0</td>
<td>24 0</td>
<td>100%</td>
</tr>
<tr>
<td>CmpE-102</td>
<td>Assembly Language Programming</td>
<td>1 0</td>
<td>22 0</td>
<td>100%</td>
</tr>
<tr>
<td>CmpE-110</td>
<td>Introduction to Digital Electronics</td>
<td>1 1</td>
<td>16 16</td>
<td>40% 60%</td>
</tr>
<tr>
<td>CmpE-124</td>
<td>Digital Design I</td>
<td>1 3</td>
<td>51 17</td>
<td>40% 60%</td>
</tr>
<tr>
<td>CmpE-125</td>
<td>Digital Design II</td>
<td>1 2</td>
<td>37 19</td>
<td>40% 60%</td>
</tr>
<tr>
<td>CmpE-126</td>
<td>Algorithm &amp; Data Structure Design</td>
<td>2 0</td>
<td>39 0</td>
<td>100%</td>
</tr>
<tr>
<td>CmpE-127</td>
<td>Microprocessor Design I</td>
<td>1 2</td>
<td>40 20</td>
<td>40% 60%</td>
</tr>
<tr>
<td>CmpE-130</td>
<td>File Processing</td>
<td>1 0</td>
<td>40 0</td>
<td>100%</td>
</tr>
<tr>
<td>CmpE-131</td>
<td>Software Engineering I</td>
<td>1 1</td>
<td>43 43</td>
<td>40% 60%</td>
</tr>
<tr>
<td>CmpE-138</td>
<td>Database Systems I</td>
<td>1 0</td>
<td>41 0</td>
<td>100%</td>
</tr>
<tr>
<td>CmpE-140</td>
<td>Computer Architecture &amp; Design</td>
<td>1 2</td>
<td>46 23</td>
<td>40% 60%</td>
</tr>
<tr>
<td>CmpE-142</td>
<td>Operating Systems Design</td>
<td>1 0</td>
<td>45 0</td>
<td>100%</td>
</tr>
<tr>
<td>CmpE-146</td>
<td>Microproc Systems</td>
<td>1 1</td>
<td>12 12</td>
<td>40% 60%</td>
</tr>
<tr>
<td>CmpE-147</td>
<td>Fund. Of SoC Design</td>
<td>1 1</td>
<td>12 12</td>
<td>40% 60%</td>
</tr>
<tr>
<td>CmpE-148</td>
<td>Computer Networking I</td>
<td>1 0</td>
<td>39 0</td>
<td>100%</td>
</tr>
<tr>
<td>CmpE-152</td>
<td>Compiler Design</td>
<td>1 1</td>
<td>46 46</td>
<td>40% 60%</td>
</tr>
<tr>
<td>CmpE-179</td>
<td>Digital Design using VHDL</td>
<td>0 2</td>
<td>0 12</td>
<td>100%</td>
</tr>
<tr>
<td>CmpE-180</td>
<td>Individual Studies</td>
<td>0 3</td>
<td>0 11</td>
<td>100%</td>
</tr>
<tr>
<td>CmpE-189</td>
<td>Special Topics: Mobile Software Design &amp; Implementation</td>
<td>1 0</td>
<td>18</td>
<td>100%</td>
</tr>
<tr>
<td>CmpE-195A</td>
<td>Senior Computer Engineering Design Project I</td>
<td>0 6</td>
<td>0 7</td>
<td>100%</td>
</tr>
<tr>
<td>CmpE-195B</td>
<td>Senior Computer Engineering Design Project II</td>
<td>0 6</td>
<td>0 5</td>
<td>100%</td>
</tr>
<tr>
<td>CmpE-197</td>
<td>Co-Op Ed Project</td>
<td>0 2</td>
<td>0 2</td>
<td>100%</td>
</tr>
</tbody>
</table>
## Table I-2 Faculty Workload Summary
### BS in Computer Engineering (Spring 2005)

<table>
<thead>
<tr>
<th>Faculty Member (Name)</th>
<th>FT or PT</th>
<th>Classes Taught (Course No./Credit Hrs.)</th>
<th>Total Activity Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Teaching</td>
</tr>
<tr>
<td>W Barrett</td>
<td>PT</td>
<td>CmpE 152/3</td>
<td>0.33</td>
</tr>
<tr>
<td>A Bindal</td>
<td>FT</td>
<td>CmpE 110 / 3</td>
<td>0.40</td>
</tr>
<tr>
<td>L Chang</td>
<td>FT</td>
<td>CmpE 202 / 3</td>
<td>0.40</td>
</tr>
<tr>
<td>F Clegg</td>
<td>PT</td>
<td>CmpE 046 / 3</td>
<td>0.32</td>
</tr>
<tr>
<td>R Fatoohi</td>
<td>FT</td>
<td>CmpE 207 / 3</td>
<td>0.60</td>
</tr>
<tr>
<td>M Fayad</td>
<td>FT</td>
<td>CmpE 195A / 1</td>
<td>0.60</td>
</tr>
<tr>
<td>J Gao</td>
<td>FT</td>
<td>CmpE 131 / 3</td>
<td>0.50</td>
</tr>
<tr>
<td>A Hambaba</td>
<td>FT</td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>D Hung</td>
<td>FT</td>
<td>CmpE 125 / 3</td>
<td>0.40</td>
</tr>
<tr>
<td>H Li</td>
<td>FT</td>
<td>CmpE 127 / 3</td>
<td>0.40</td>
</tr>
<tr>
<td>S Meldal</td>
<td>FT</td>
<td>CmpE 180 / 1-3</td>
<td>0.20</td>
</tr>
<tr>
<td>G Pour</td>
<td>FT</td>
<td>CmpE 126 / 3</td>
<td>0.80</td>
</tr>
<tr>
<td>H Ozemek</td>
<td>FT</td>
<td>CmpE 124 / 3</td>
<td>0.40</td>
</tr>
<tr>
<td>M Robinson</td>
<td>PT</td>
<td>CmpE 046 / 3</td>
<td>0.80</td>
</tr>
<tr>
<td>S Shim</td>
<td>FT</td>
<td>CmpE 138 / 3</td>
<td>0.40</td>
</tr>
<tr>
<td>X Su</td>
<td>FT</td>
<td>CmpE 148 / 3</td>
<td>0.40</td>
</tr>
<tr>
<td>L Wesley</td>
<td>FT</td>
<td>CmpE 295 / 3</td>
<td>0.20</td>
</tr>
<tr>
<td>W Yu</td>
<td>FT</td>
<td>CmpE 189 / 3</td>
<td>0.60</td>
</tr>
</tbody>
</table>
## Table I-2 Faculty Workload Summary (cont.)
BS in Computer Engineering (Fall 2004)

<table>
<thead>
<tr>
<th>Faculty Member (Name)</th>
<th>FT or PT</th>
<th>Classes Taught (Course No./Credit Hrs.)</th>
<th>Total Activity Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Teaching</td>
</tr>
<tr>
<td>W Barrett</td>
<td>PT</td>
<td>Cmpe 102/3</td>
<td>0.40</td>
</tr>
<tr>
<td>A Bindal</td>
<td>FT</td>
<td>Cmpe 110 / 3</td>
<td>0.60</td>
</tr>
<tr>
<td>L Chang</td>
<td>FT</td>
<td>Cmpe 104&amp;135/3</td>
<td>0.60</td>
</tr>
<tr>
<td>F Clegg</td>
<td>PT</td>
<td>Cmpe 126 / 3</td>
<td>0.32</td>
</tr>
<tr>
<td>R Fatoohi</td>
<td>FT</td>
<td>Cmpe 206 / 3</td>
<td>0.60</td>
</tr>
<tr>
<td>M Fayad</td>
<td>FT</td>
<td>Cmpe 195A / 1</td>
<td>0.67</td>
</tr>
<tr>
<td>J Gao</td>
<td>FT</td>
<td>Cmpe 131 / 3</td>
<td>0.60</td>
</tr>
<tr>
<td>A Hambaba</td>
<td>FT</td>
<td>Cmpe 127 / 3</td>
<td>0.00</td>
</tr>
<tr>
<td>D Hung</td>
<td>FT</td>
<td>Cmpe 125 / 3 Cmpe 295 / 3</td>
<td>0.40</td>
</tr>
<tr>
<td>H Li</td>
<td>FT</td>
<td>Cmpe 127 / 3</td>
<td>0.40</td>
</tr>
<tr>
<td>S Meldal</td>
<td>FT</td>
<td>Cmpe 180 / 1-3 Cmpe 195B / 3 Cmpe 298 / 1-6</td>
<td>0.20</td>
</tr>
<tr>
<td>G Pour</td>
<td>FT</td>
<td>Sabbatical</td>
<td>1.00</td>
</tr>
<tr>
<td>H Ozemek</td>
<td>FT</td>
<td>Cmpe 124 / 3 Cmpe 143 / 3</td>
<td>0.40</td>
</tr>
<tr>
<td>M Robinson</td>
<td>PT</td>
<td>Cmpe 046 / 3 Cmpe 130 / 3</td>
<td>0.80</td>
</tr>
<tr>
<td>S Shim</td>
<td>FT</td>
<td>Cmpe 138 / 3 Cmpe 142 / 3</td>
<td>0.60</td>
</tr>
<tr>
<td>X Su</td>
<td>FT</td>
<td>Cmpe 148 / 3 Cmpe 209 / 3</td>
<td>0.40</td>
</tr>
<tr>
<td>L Wesley</td>
<td>FT</td>
<td>Sabbatical</td>
<td>0.00</td>
</tr>
<tr>
<td>W Yu</td>
<td>FT</td>
<td>Cmpe 196L / 3 Cmpe 220 / 3 Cmpe 286 / 3</td>
<td>0.60</td>
</tr>
</tbody>
</table>
Appendix II - BACKGROUND INFORMATION

1. General Information

College of Engineering
One Washington Square • San José, California USA, 95192-0080
Tel: 408-924-3800
Fax: 408-924-3818
E-mail: coe@email.sjsu.edu

Dean: Dr. Belle Wei
Associate Dean of Graduate and Extended Studies: Dr. Ahmed Hambaba
Associate Dean of Research: Dr. Kevin Corker
Associate Dean of Undergraduate Studies: Dr. Ping Hsu

2. College of Engineering’s Mission

We will provide empowering educational opportunities to students for their technical, professional and social development in a competitive and dynamic global society. We will build a vibrant community of students, faculty, staff, alumni, and industry professionals through strategic collaborations with Silicon Valley, California, national and global partners.

College of Engineering Goals
The College has identified three goals to achieve its vision and mission.

• To be preeminent among undergraduate engineering institutions in the U. S.
  ♠  Nationally recognized for engagement with local and global industries
  ♠  Preferred California State University campus for undergraduate engineering education
  ♠  Nationally recognized for curriculum and quality of undergraduate experience

• To be a nationally recognized, professionally oriented graduate engineering program
  ♠  Nationally recognized for an applied technological curriculum
  ♠  Coordinated graduate and outreach programs responsive to regional industry

• To be the preferred partner for applied research and development
  ♠  Initiating centers of excellence and programs

3. Alignment with University Mission and Goals
University Mission
In collaboration with nearby industries and communities, SJSU faculty and staff are
dedicated to achieving the university's mission as a responsive institution of the State
of California. To enrich the lives of its students, to transmit knowledge to its students
along with the necessary skills for applying it in the service of our society, and to
expand the base of knowledge through research and scholarship.

“Goals-
For both undergraduate and graduate students, the university emphasizes the following
goals:

❖ In-depth knowledge of a major field of study.
❖ Broad understanding of the sciences, social sciences, humanities, and the arts.
❖ Skills in communication and in critical inquiry.
❖ Multi-cultural and global perspectives gained through intellectual and social
  exchange with people of diverse economic and ethnic backgrounds
❖ Active participation in professional, artistic, and ethnic communities.
❖ Responsible citizenship and an understanding of ethical choices inherent in
  human development.”

“Character and Commitment-
San José State University is a major, comprehensive public university located in the
center of San José and in the heart of Silicon Valley. SJSU is the oldest state university
in California. Its distinctive character has been forged by its long history, by its
location, and by its vision - a blend of the old and the new, of the traditional and the
innovative. Among its most prized traditions is an uncompromising commitment to
offer access to higher education to all persons who meet the criteria for admission,
yielding a stimulating mix of age groups, cultures, and economic backgrounds for
teaching, learning, and research. SJSU takes pride in and is firmly committed to
teaching and learning, with a faculty that is active in scholarship, research,
technological innovation, community service, and the arts.”

4. Faculty and Students

Table II.1 provides a summary of the faculty and student counts for the Fall Semester of
2005 for the College and each program under evaluation.

Table II.1 Faculty and Student Head Counts, Fall 2005

<table>
<thead>
<tr>
<th>HEAD COUNT</th>
<th>FTE</th>
<th>TOTAL STUDENT CREDIT HOURS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenure Track Faculty</td>
<td>66</td>
<td>5</td>
</tr>
</tbody>
</table>

II-2
Other Teaching Faculty (excluding student assistants) | 2 | 99 | 31.26
---|---|---|---
Student Teaching Assistants | 0 | 42 | 8.15
Undergraduate Students | 2367 | 647 | 2593.45 | 38901.75
Graduate Students | 513 | 1022 | 645.86 | 9687.9
Professional Degree Students | 0 | 0 | 0 | 0

FTE: Full-time Tenure Track Faculty = Tenured & Probationary. Part-time Tenure Track Faculty = Faculty Early Retirement Program (FERP). Full-time Other Teaching faculty = Lecturer at 1.00. Part-time Other Teaching Faculty = Lecturer < 1.00. Student Teaching Assistants = Grad. Assistants & Teaching Associates, which we only considered as part-time only.

5. Engineering Personnel and Policies

Personnel – See Table II.2.

Table A-2. Personnel and Students

<table>
<thead>
<tr>
<th>College of Engineering (Year: Fall 2005)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Head Count</strong></td>
</tr>
<tr>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Administrative</td>
</tr>
<tr>
<td>Faculty (tenure-track)</td>
</tr>
<tr>
<td>Other Faculty (excluding student Assistants)</td>
</tr>
<tr>
<td>Student Teaching Assistants</td>
</tr>
<tr>
<td>Student Research Assistants</td>
</tr>
<tr>
<td>Technicians/Specialists</td>
</tr>
<tr>
<td>Office/Clerical Employees</td>
</tr>
<tr>
<td>Others</td>
</tr>
<tr>
<td>Undergraduate Student Enrollment</td>
</tr>
<tr>
<td>Graduate Student Enrollment</td>
</tr>
</tbody>
</table>

6. Non-Academic Support Units

6.1 The College of Engineering Computing Systems

The College of Engineering Computing Systems (ECS) is comprised of five full-time employees. Each individual is assigned an area of interest or specialization. The areas of interest and specialization are: faculty and staff desktop support, networking, World
Wide Web (WWW), UNIX laboratories, and academic instructional laboratories. Several student assistants are shared by all ECS personnel.

6.1.1 Faculty and Staff Support

ECS develops and supports laboratory, faculty, and staff computer systems; implements, configures and maintains application software; network operating systems; provides Internet connectivity, and manages hardware and software licenses. ECS ensures the functionality, applicability, and maximum uptime of laboratory servers and workstations. As well, ECS ensures operational, reliable, secure, and optimal computer systems for academic computer laboratories and desktops.

The following list outlines specific work activities performed by ECS support personnel:

(1) Scott Pham, Information Systems Analyst, Career Level

Plan, design, specify, evaluate select, order, install, configure, maintain, and administer software and hardware for servers, clients, and peripherals in academic computer laboratories. (See Exhibit II-3a)

As needed, plan, specify, evaluate select, order, install, configure, and maintain software and hardware for faculty and staff desktop computers and peripherals.

Troubleshoot laboratory and user operating systems and application software. Diagnose and repair computers and peripheral equipment. Develop procedures for secure and efficient laboratory use. Development of quick-recovery procedures to restore corrupt laboratory computer systems.

Support faculty and staff as technical consultants for software, operating systems, and Internet connectivity issues.

Maintain currency of virus protection. Maintain FTP server with current virus software and updates. Maintain frequent email and personal contact with faculty and staff.

(2) William Black, Operating Systems Analyst, Career Level

Design, implement, and maintain UNIX laboratory hardware and software for the purpose of coursework and research. (See Exhibit II-3b)

Provide supplemental support to department technicians.

Assist in developing department and college-wide systems and policies.

Investigate and evaluate new products and solutions.

Assist the Network Administrator with developing and implementing network configuration changes.

Work directly with faculty and staff to resolve individual computer issues. (Help Desk)

(3) In the Process of Hiring, Information Systems Analyst, Career Level, Webmaster
Creates and manages the information content (words and pictures) and organization of the COE Web site (http://www.engr.sjsu.edu).

Manages the computer server and technical programming aspects of the Web site.

Educates and supports faculty and staff with Web related functions.

Works with ECS staff, department Chairs and Dean to establish the overall COE Web site design and policies.

The College of Engineering Webmaster typically "does it all." The Webmaster is someone with graphics design background who has also Web site creation skills and programming skills; mainly knowledge and experience with HTML, JAVA, and DHTML. The Webmaster administers multiple servers (i.e.: Web, FTP, Email, ListServer, Database, Applications, Files server) and writes or implement programs required by the faculty and staff.

(4) Ben Rashid, Information Systems Analyst, Career Level

The hardware technician provides hardware support and maintenance for the College of Engineering. The hardware technician is expected to: maintain, install, repair, and troubleshoot component level hardware in microcomputer systems, peripheral equipment, and local area networks; provide technical support for faculty and staff; act as liaison with hardware and software vendors; recommend upgrade requirements for software and hardware; maintain and monitor the College of Engineering computer inventory; and train and work closely with student assistants.

Specifically, Mr. Rashid troubleshoots email problems, desktop network issues, printing problems (including network printing), system performance issues, peripheral configuration, user account management, system security, part repair and service, hardware and software compatibility issues, and user data migration when new systems are installed.

(5) Kindness Israel, Information Systems Analyst, Expert Level, Director

The ECS Director is responsible for developing, implementing, managing, and maintaining cost-effective, reliable College-wide computing and network systems, which includes administrative systems, instructional computer labs, and Internet access. The Director makes specifications for procurement, installation, support, and maintenance of requisite hardware and software for the COE, makes recommendations for all Engineering departments, develops and implements operational policies, procedures, and practices necessary for reliable delivery of computing and network services in consultation with the Central Computing and Telecommunications, coordinates technology projects with the appropriate faculty, staff, and students, builds consensus and solicits input when making significant changes, and maintains good channels of communication in terms of decisions and policies associated with the delivery of technical services within the College. He provides support and direct supervision of personnel subordinate to this position (5 full time staff and 40 hours/week student assistants) including initiating and monitoring project planning and reviews, recommending personnel actions, preparing performance reviews, job descriptions,
participates in recruitment of ECS personnel. He develops and implements requests and proposals for acquisition of equipment, software, supplies, and services, and assists in providing technical training for faculty and staff. The director also develops and maintains databases, records, documents, and files associated with computing and networking systems.

6.2 ECS Scope of Responsibility

6.2.1 Network Infrastructure
Responsible Person(s): Kindness Israel, William Black, Scott Pham
Scope: COE Building, IS Building, Aviation Building, All Departments
Hardware/Software:
- COE IP Copper/Fiber Backbone (Currently 2000 ports)
  - 4 Alcatel 9 Slot OmniSwitches
  - 15 Alcatel 5 Slot OmniSwitches
  - 16 Alcatel 3 Slot OmniSwitches
  - 7 Alcatel 5024 OmniStacks
  - 4 Alcatel 1032 OmniStacks
  - Dozens of Netgear and Linksys Hubs
  - 6506 Cisco Router
  - 2511 Cisco Router
- COE Wireless Network
  - Linux Router/Gateway
  - 8 Wireless Linksys Access Points
  - RADIUS Server
- SUSU Wireless Network
  - Router
  - 4 Switches
  - 16 Cisco 1200 Access Points
Design and Implementation of New Network (Upgrade to 4,000 ports)
- New Cat6 Copper and Multimode Fiber Infrastructure by May 2005
- New Cisco Electronics by August 2005
Student/Faculty Impact: Administration, Staff, Faculty, and Students
Policy/Guidelines: Internet usage policies are determined by the CSU Chancellor's office.

6.2.2 Core Servers
Responsible Person(s): Kindness Israel, William Black, Scott Pham
Scope: COE, All Departments
Hardware/Software:
- Firewall (Linux using iptables)
- Xvision Server (Alcatel SNMP Server)
- VPN Server (Firewall access for Faculty)
- 3 DNS Servers (Domain Name Server Address Resolution)
- DHCP Server (IP Address Leasing)
- MRTG Monitor (Security Monitoring)
- MIRROR Server (Linux Software Application Server)
3 ENGR MS Active Directory Servers (Primary Domain Controller)
Oracle 8i INFO Database (Faculty/Staff Database)
Oracle 8i CMPE Database (CMPE 138, 143)
Application Development Server (Opentrak, Peoplesoft Access)

Student/Faculty Impact: Administration, Staff, Faculty, and Students
Policy/Guidelines: ECS is responsible for the procurement, installation, and maintenance of all hardware and software necessary to ensure the smooth operation of the COE computing infrastructure.

6.2.3 COE Academic Laboratories
Responsible Person: Scott Pham
Scope: E333, E390, E391, E407, E393, E394
Hardware/Software: 150 Pentium Computers, Domain Controller, and File Server / MS Win2000
Student/Faculty Impact: All Undergraduate Students, and Faculty
Policy/Guidelines: ECS is responsible for the procurement, installation, and maintenance of all hardware and software necessary to conduct computer laboratory instruction in the COE academic laboratories (Exhibit II-3a).

6.2.4 Open Laboratories
Responsible Person: Scott Pham
Scope: E405 and E390
Hardware/Software: 50 Pentium Computers, Domain Controller / MS WinNT
Student/Faculty Impact: Undergraduate, Graduate Students, and Faculty
Policy/Guidelines: ECS is responsible for the procurement, installation, and maintenance of all hardware and software necessary to conduct computer laboratory instruction in the COE open laboratories (Exhibit II-3a).

6.2.5 Department Laboratories
Responsible Person(s): Faculty members who conduct classes in the laboratories and department technicians.
Scope: Network access is provided by ECS.
Hardware/Software: MS Operating Systems, Sun Solaris, Linux
Student/Faculty Impact: Undergraduate, Graduate Students, and Faculty
Policy/Guidelines: ECS provides network access to all department laboratories. ECS provides secondary-level support to every department and research laboratory. Secondary-level support consists of answering any technical questions posed by the faculty or department technician thus ensuring the successful implementation of the project or class. Any ECS person may be called upon to assist.

6.2.6 Research Laboratories
Responsible Person(s): Faculty members who originally obtained the grant and department technicians.
Scope: Network access is provided by ECS.
Hardware/Software: Varies
Student/Faculty Impact: Graduate Students, Faculty
Policy/Guidelines: ECS provides network access to research laboratories such as the HAIL Lab, Cisco Laboratory, and faculty research laboratories. ECS provides secondary-level support to every department and research laboratory. Secondary-level support consists of answering any technical questions posed by the faculty or department technician thus ensuring the successful implementation of the project. Any ECS person may be called upon to assist.

6.2.7 UNIX (Solaris) Laboratories
Responsible Person(s): William Black, Kindness Israel
Scope: Primarily EE and CMPE Cadence Laboratories and Research Laboratories
Hardware/Software: 120 Sun Solaris, IBM AIX, and Linux on Intel Architecture
Student/Faculty Impact: Graduate Students enrolled in Cadence Classes, Department Graduate Research Projects
Policy/Guidelines: ECS provides UNIX support for all departments of the COE (Exhibit II-3b).

6.2.8 WWW.ENGR.SJSU.EDU Website
Responsible Person: In the Process of Hiring
Scope: COE, All Departments
Hardware/Software: Dell Linux Server / Apache, MySQL, PHP, WebAdmin, Photoshop
Student/Faculty Impact: All Administrative, Faculty, Staff, and Students
Policy/Guidelines: ECS maintains the COE home page and provides support for all departments and faculty. Many departments have their own webmasters. ECS has always sought to coordinate and streamline the efforts of the department webmasters with the COE main page.

6.2.9 Administrative Desktop Support
Responsible Person: Ben Rashid
Scope: Dean and Graduate Studies Offices, CEE, ChemE
Hardware/Software: Domain Controller and File Server / Microsoft Windows and Office Suite Software - All Versions, PeopleSoft, Oracle Discover Clients, Photoshop, and assorted workflow applications.
Student/Faculty Impact: Administration, Staff, and Faculty
Policy/Guidelines: ECS provides front-line support to the Dean and Graduate Studies, and CEE. The other departments in the COE have department-level technician support. ECS provides secondary-level support to every department. Secondary-level support consists of answering any technical questions posed by the faculty or department technician thus ensuring the successful implementation of the department's operation. Any ECS person may be called upon to assist.

6.2.10 Email Support:
Lotus Notes
Responsible Person: Ben Rashid
Scope: COE, All Departments
Hardware/Software:
Lotus Notes Servers - Central Computing
Lotus Notes Clients - Ben Rashid
Student/Faculty Impact: Administration, Staff, and Faculty
Policy/Guidelines: It is the responsibility of ECS to install and configure the Lotus Notes client. Lotus Notes servers are administered by Central Computing.
Lotus Notes is the preferred (and recommended) email service for administrative, staff, and faculty usage.

Eudora
Responsible Person: Scott Pham
Scope: COE, All Departments
Hardware/Software: Eudora Clients
Student/Faculty Impact: Administration, Staff, and Faculty
Policy/Guidelines: It is the responsibility of ECS to install and configure the Eudora client. Department technicians also assist with email client installations.

MS Outlook, Mozilla, and Other Email Clients
Responsible Person(s): ECS Staff
Scope: COE, All Departments
Hardware/Software: Eudora Clients, Mozilla, Netscape, and MS Outlook
Student/Faculty Impact: Administration, Staff, and Faculty
Policy/Guidelines: It is the responsibility of ECS to install and configure email clients in the absence of department technicians or in instances where special problems are encountered.

6.2.11 Faculty and Staff Desktop Support
Responsible Person(s): Department Technicians, Ben Rashid, ECS Staff
Scope: COE, All Departments
Hardware/Software: Microsoft Windows - All Versions
Student/Faculty Impact: Administration, Staff, and Faculty
Policy/Guidelines: ECS provides front-line support to the Dean and Graduate Studies, and CEE. The other departments in the COE have department-level technician support. ECS provides secondary-level support to every department. Secondary-level support consists of answering any technical questions posed by the faculty or department technician thus ensuring the successful implementation of the department's operation. Any ECS person may be called upon to assist.

6.2.12 Backups
Responsible Person(s): ECS Staff
Scope: COE, All Departments
Hardware/Software: Intel Architecture, Sun Sparc, Network Devices, Core Servers, File Servers, and Domain Controllers / Linux, Solaris, Windows 2000, Databases, Student Accounts, and Research data
Student/Faculty Impact: Administrative, Faculty, Staff, and Students
Policy/Guidelines: Kindness Israel performs daily and weekly backups on the COE core servers, databases, and Linux student accounts. Solaris student accounts are the
responsibility of William Black, Scott Pham is responsible for the academic laboratory domain controllers and related student accounts, and Ben Rashid is responsible for the administrative domain controllers and file servers. In the Process of Hiring is responsible for the COE WWW server and related accounts. Sigurd Meldal performs daily backups on the CMPE administrative accounts. The other COE departments perform no regular or scheduled backups.

6.2.13 Anti-Virus and Security
Responsible Person(s): Scott Pham, Kindness Israel, William Black
Scope: COE, All Departments
Hardware/Software: Intel Architecture / Microsoft Windows - All Versions
Student/Faculty Impact: Administrative, Faculty, Staff, and Students
Policy/Guidelines: The COE purchases McAfee AntiVirus software for distribution to the faculty and staff. ECS oversees and ensures that antivirus software updates are distributed to the COE department technicians for installation.

Security is primarily a subdivision of networking. The primary network defense is the COE firewall. Unfortunately, an inordinate amount of time is required to track-down abusers of the system. The security and best practices of the CSU are posted on the ECS Networking Web Page.

6.2.14 Software
Microsoft CD Library and Distribution Server (ecs_apps)
  Responsible Person: Scott Pham
  Scope: COE, All Departments
  Hardware/Software: MS Operating Systems, MS Office Suite
  Student/Faculty Impact: Faculty, Technical Staff
  Policy/Guidelines: The COE purchases a minimal number of distribution disks and licenses. The original CDs are archived and the images are distributed via Juanita's share server which can be accessed using a password and shared link. All department technicians use the share server daily. Certain bootable CDs must be replicated from the original CDs. Juanita performs the CD creation task for the COE.

Software Licenses
  Responsible Person: Scott Pham
  Scope: Faculty
  Hardware/Software: Matlab, McAfee, ASAP Contracts
  Student/Faculty Impact: Faculty and Students
  Policy/Guidelines: ECS obtains and maintains the software licenses. EE also has an extended version of Matlab applications. Matlab and AutoCad are distributed to the department technicians via the ECS application server along with non-licensed software.

6.2.15 COE and ECS Department Purchases
Responsible Person(s): Kindness Israel, Scott Pham, and Ben Rashid
Scope: COE, ECS, All Departments
Hardware/Software: All computer hardware and software necessary to maintain the COE and ECS departments.

Student/Faculty Impact: Administrative, Faculty, and Staff

Policy/Guidelines: In addition to the COE Dean and Graduate Studies office purchases, ECS also researches and advises faculty members and technical staff about where and how to obtain the most cost efficient hardware and software.

6.2.16 Staff Training
Responsible Person(s): ECS Staff
Scope: Department Technicians
Hardware/Software: Intel and Sun / Microsoft Windows - All Versions, Linux, Sun Solaris

Student/Faculty Impact: Department Technicians
Policy/Guidelines: ECS has conducted classes for department technicians and maintains a mailing list for the purpose of keeping the technical staff informed of upcoming relevant events and special classes. By and large, a constant dialog and exchange of information is conducted between ECS and the technical staff.

6.2.17 Walk-In and Phone Support
Responsible Person(s): ECS Staff
Scope: COE, All Departments
Hardware/Software: All.

Student/Faculty Impact: Faculty, Technical, and Administrative Staff
Policy/Guidelines: ECS has an "open door" policy toward questions and eagerly looks forward to helping any COE faculty, staff, or student solve their computer or network problems.

6.2.18 Special Projects
Responsible Person: Kindness Israel
Scope: Students
Hardware/Software: Linux / Linux

Student/Faculty Impact: Students
Policy/Guidelines: Kindness Israel is the sponsor of the San Jose State Linux Users Group (SJSULUG). The club meets in E239 and has built several Linux clusters for research projects.

6.2.19 Student Organization Rooms
Responsible Person(s): Department Technicians
Scope: Departments
Hardware/Software: Intel / Microsoft Operating Systems - All Versions.

Student/Faculty Impact: Faculty, Students
Policy/Guidelines: The department club rooms are maintained by the departments. ECS provides network access.

6.2.20 Development of Disaster Recovery Documentation/FAQs
Responsible Person(s): ECS Staff
Scope: COE, ECS
Hardware/Software: All
Student/Faculty Impact: ECS Staff
Policy/Guidelines: Every ECS staff member is required to produce a disaster recovery booklet or spreadsheet of computers under their care. The documentation contains the name, type, location, and any pertinent information about how to login, shutdown, and restart the machine and its primary services. ECS also maintains several

a-2.21. Software Development
Responsible Person(s): Kindness Israel, Student Assistant
Scope: Administration, Faculty, Staff
Hardware/Software: Linux on Intel Architecture / Advisor, Room Scheduler, Monitor Software, OpenTrak, Student Data, Login Accounts, COE Databases, Department Queries, UNIX Scripts.
Student/Faculty Impact: Administrative, Faculty, Students
Policy/Guidelines: ECS has traditionally employed a student programmer for the purpose of providing direct access to SIS and PeopleSoft data. These data have been used to create a myriad number of products and solve complex IT problems.

a-2.22. Inventory and Resources
Responsible Person: Kindness Israel
Scope: COE Building
Hardware/Software: Annual Inventory conducted with FD&O
Student/Faculty Impact: N/A
Policy/Guidelines: FD&O requires that all computer items and network equipment costing more than $5,000 be accountable. Overall, ECS is directly responsible for over a million dollars worth of computer and network equipment.

a-2.23. Computer and Printer Repair
Responsible Person(s): ECS Staff, Student Assistant
Scope: Academic Laboratories, Administrative Offices, Core Servers, ECS Desktops
Hardware/Software: Core Servers, Laboratory Computers, Administrative Computers, Sun Servers, Printers
Student/Faculty Impact: Undergraduate Students, Faculty, Administrative Staff
Policy/Guidelines: The academic laboratories are the sole responsibility of ECS. The Dean's office and Graduate Studies office are the sole responsibility of ECS. ECS also maintains the software and hardware contracts for the Cadence Solaris laboratories but does not purchase the licenses. Printers are generally cleaned and repaired locally by Ben Rashid or a student assistant.

b. Student Advising and Services

b-1. College of Engineering Units

The College of Engineering has two college-level student advising and supporting units: the Engineering Student Advising Center and the MESA Engineering Program.
The Engineering Advising Center was established in Spring 2005. The Center provides the following services to all engineering students:

- General Education requirement advising
- Monitoring and advising of students on probation
- Study skills workshops
- New Student Advising

The goal of the MESA Engineering Program is to increase the number of competent and qualified graduates entering the engineering profession from groups with low eligibility rates in college admissions. The program provides the following services: student study center, Academic Excellence Workshops, professional development workshops, freshmen orientation, career advising, and supports to student organizations.

c. Design and Fabrication Services

College of Engineering Central Shop is staffed by two full-time mechanics and several part-time student assistants. Central Shop provides a variety of services in the shops, laboratories, and related areas in support of the teaching and research needs of the instructional programs. The responsibilities of the central shop are maintenance and repair of mechanical equipment, design, fabrication and installation of teaching devices and apparatus for instructional, student projects, and faculty research needs, and providing guidance to faculty and students on machine operations.
Appendix III – Program Profile

A: Student Guide Sample ...................................................................................III-2
B: Curriculum Changes Sample .......................................................................III-23
C: Course Journal Samples ...............................................................................III-25
D: Sample Course Feedback Questions .......................................................... IV-62
A: Student Guides

BS in Computer Engineering
Student Guide

San José State University
Computer Engineering Department

This Booklet Is Associated With

Booklet Date:
Fall 2004

Revised 11/10/04
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Information</td>
<td>4</td>
</tr>
<tr>
<td>Office Location</td>
<td>4</td>
</tr>
<tr>
<td>Office Hours</td>
<td>4</td>
</tr>
<tr>
<td>Department Chair: Dr. Sigurd Meldal</td>
<td>4</td>
</tr>
<tr>
<td>Faculty</td>
<td>4</td>
</tr>
<tr>
<td>Program Description</td>
<td>5</td>
</tr>
<tr>
<td>Rules and Policies</td>
<td>6</td>
</tr>
<tr>
<td>Disqualification in the Major</td>
<td>9</td>
</tr>
<tr>
<td>Repeating courses for Academic Renewal</td>
<td>9</td>
</tr>
<tr>
<td>Reinstatement after Academic Disqualification</td>
<td>9</td>
</tr>
<tr>
<td>Requirements for B.S. Degree</td>
<td>10</td>
</tr>
<tr>
<td>Sample Four-Year Plan</td>
<td>11</td>
</tr>
<tr>
<td>General Education Checklist</td>
<td>12</td>
</tr>
<tr>
<td>Major Form</td>
<td>14</td>
</tr>
<tr>
<td>Substitution of Course in Major Form</td>
<td>15</td>
</tr>
<tr>
<td>Advising Form</td>
<td>16</td>
</tr>
<tr>
<td>Advanced Registration Form</td>
<td>17</td>
</tr>
<tr>
<td>Transfer Course Equivalency Form</td>
<td>18</td>
</tr>
</tbody>
</table>
General Information

Office Location

Engineering Building, corner of San Fernando & 7th Streets, San Jose, 2nd Floor - Room 284

Office Hours

9:00 am - 4:00 pm
(closed for lunch 12noon – 1:00PM)

Telephone: (408) 924-4150    Fax: (408) 924-4153

Email Address: cmpe@email.sjsu.edu    Website Address: http://www.cmpe.sjsu.edu

Department Chair: Dr. Sigurd Meldal

Faculty

Dr. William Barrett
Compiler Technology and Biometrics

Dr. Ahmet Binal
Computer Architecture and Design

Dr. Lee Chang
MSSE Graduate Advisor
Software Systems

Dr. Rod Fatoohi
Computer Networking

Dr. M.E. Fayad
Object-Oriented Software Engineering Design

Dr. Jerry Gao
Software Engineering
Internet & Info Technology

Dr. Ahmed Hambaba
Software and Information Engineering

Dr. Donald Hung
Compiler Technology and Biometrics

Dr. Harry Li
Multimedia System

Dr. Haluk Ozemek
Embedded Hardware Design
Biomedical Engineering

Dr. Gilda Pour
Software Engineering
Agent-Oriented Enterprise Software

Dr. Michael Robinson
File Processing, Memory Systems

Dr. Simon Shim
BSSE Undergraduate Advisor
Multimedia Software Systems & Databases

Dr. Xia Su
Computer Network, Multimedia
Network Security

Dr. Leonard Wesley
A.I., Robotics Agent-Based Technology
Network Management

Dr. Weider Yu
Software Engineering
Software QA & Testing Methods
Program Description

The Computer Engineering Department offers degree programs in Computer Engineering (BS and MS) and Software Engineering (BS and MS).

The mission of the Computer Engineering department is to be the leading provider of high quality, practice-oriented computer and software engineering graduates to California and the nation, and to enhance engineering knowledge through research and scholarship. The computer and software engineering curricula provide a solid background in science and engineering. The majors cover topics ranging from the design of computer hardware and the core software that makes computers run, the design of computing components of other systems (such as in cell-phones, aircraft, digital cameras, etc.), the design and construction of computer networks and of software for truly large-scale enterprise systems. Computer and software engineering students are expected to choose a set of elective courses to focus on a particular area of specialization. Graduates will be able to apply these skills to specific engineering applications.

Every student is assigned to a faculty advisor. The department expects every student to consult regularly with their advisors and to obtain the advisor's approval and signature on all required registration forms. Undergraduate transfer students have a special responsibility to obtain approval of transfer credits with the assistance of their advisor during their first semester at San Jose State University.

The program prepares students to enter the profession immediately or to go on to graduate school. The undergraduate computer engineering curriculum is accredited by the Accreditation Board for Engineering and Technology (ABET).

The objective of the BS Computer Engineering program is to graduate students who have a solid grasp of the fundamentals, and who demonstrate a practical, participatory and professional attitude towards their chosen profession. Three to five years after their graduation we expect the students of the program to have:

- Demonstrated an understanding of the fundamentals of the computer engineering, including its scientific principles, rigorous analysis and creative design.
- Demonstrated the ability to practice hands-on engineering, applying engineering concepts to real world problems.
- Demonstrated effective communication, interpersonal skills, initiative, teamwork, leadership, and professional attitudes and ethics.
- Demonstrated continued intellectual flexibility and growth and a capability for career advancement.

Note: Students should periodically review the B.S. Computer Engineering Student Guide on the Computer Engineering department's web site or obtain the B.S. Computer Engineering Student Guide booklet for the latest information regarding the B.S. in Computer Engineering Program.
Rules and Policies

Major Advisor
A major advisor is a representative of the program who can assist you in selecting courses and develop a plan for fulfilling the SJSU and major requirements. You must consult your major advisor at least once each semester to remove your hold so that you may sign up for next semester’s courses (before the end of the semester).

Writing Skills Test (WST) and Engr 100W
You must pass the WST and have upper division standing in order to register for any advanced general education course (including Engr 100W). Engr100W is a prerequisite for all Computer Engineering senior and technical elective courses. You are urged to take the WST as early as possible.

Placement Examinations
All undergraduate students must take the Entry Level Mathematics (ELM) Exam or be exempted from it prior to placement in the appropriate university mathematics coursework. All students who wish to enroll in the following courses are required to take the corresponding placement examinations.

- CmpE 126 requires CmpE 101
- CmpE 124 requires EE 101.
- Engl 1A requires English Placement Test\(^1\)
- Math 30 or Math 20 requires Calculus Placement Examination\(^2\)
- Phys 70 requires Physics Placement Test, Physics 50 may be taken without the qualifying exam

Drop Procedure
A student may petition to drop a course after the third week of instruction only for serious and compelling reasons. Poor performance in a class is not considered a serious and compelling reason for late-drop. Verification and meeting with the University Academic Services office is necessary. Please see more detailed policy in SJSU University catalog.

Prerequisites and Corequisites
You can take a CmpE course only if you have completed all prerequisites of the course before taking it. (See prerequisite listing at the end of this guide). A co-requisite class is one that can be taken at the same time as another class. A student who takes a course without satisfying both of the above conditions will either be dropped by the instructor, asked to retake one or more courses in the proper order, or receive a failing grade.

---

\(^1\) A grade of 550 or better on the SAT and a grade of 24 or greater on the English part of the ACT will exempt student from this exam.

\(^2\) A grade of 550 or better on the SAT and a grade of 23 or greater on the Math part of the ACT will exempt student from this exam.
Course Load
You should adjust your course load based on your scholastic record, working hours, and other factors. You should discuss your individual situation with your major advisor. Students will not be allowed to register for more than 18 units per semester without approval from the department chair/major advisor with the Petition for Excess Units form.

Technical Electives
9 semester units of upper-division technical electives are required. You can select the technical electives from the approved list or petition to take a course not on the list. The choice of technical electives must be made in order to complete the major form. You need your major advisor's approval (on the major form) to take any elective course that is not on the approved list. To secure this approval will require your submitting a syllabus defining the selected course. Lower division courses cannot be used as technical electives.

General Education
Questions on GE requirements should be directed to the GE Advisors in Student Services.

Major Form
An approved major form on file is required for taking any senior level CmpE courses. A sample major form is included in this booklet. The following is the process of completing your Major Form:
1. Download the Major Form from the CmpE website.
2. See “Major Form Guidelines” for detailed information.
3. Pick up a graduation application from the Student Services Center and submit it with your major form.
4. Bring the major form to your major advisor for approval.
5. Bring the approved major form and supporting documents to the CmpE office for grade verification and department chair approval.
6. The approved major form packet will be delivered to the Student Services Center upon final approval.

Transfer Evaluation
Before enrolling in CmpE 124 and CmpE 126, you must see your Major Advisor to review credit for mathematics, physics, chemistry, and engineering coursework taken elsewhere. Students who fail to do so will either be dropped by the instructor or receive a failure grade.

Online course equivalent information from junior colleges is available on the internet at: http://artic.sjsu.edu. This web site offers information on which courses can be transferred from 131 colleges that have articulation agreements with San Jose State University.
The following steps are required for a transfer credit evaluation:

1. Obtain a set of unofficial transcripts showing all the mathematics, physics, chemistry, and engineering courses taken elsewhere that you consider equivalent to the corresponding SJSU courses.

2. If applicable, obtain copies of catalog descriptions of pertinent courses that were taken at schools other than California community colleges. The King Library normally has copies of catalogs for most U.S. Colleges.

3. If applicable, fill out, attach catalog descriptions, and submit to the appropriate SJSU departments the proper equivalency evaluation forms for those courses taken at schools other than California community colleges. The U.S. college forms can be obtained from the CmpE Department, while the foreign college forms are processed through the Student Services Center. Following review, these forms should be returned to the CmpE Department.

4. Complete the worksheet included in the transfer evaluation packet in ink. A list of course equivalencies between California community colleges and SJSU is included. Courses not found in the list require completion of equivalency evaluation forms by the pertinent department to complete the evaluation.

5. If all your transfer coursework was done at California community colleges, attach the set of transcripts to the completed worksheet and submit to your Major Advisor. Within a week or so, unless there are problems, your official transfer evaluation should be complete and placed in your file with the CmpE department.

6. If part (or all) of your pertinent transfer coursework was taken at schools other than California community colleges, attach the set of transcripts and copies of the signed equivalency evaluation forms to the completed worksheet and submit in person to your major advisor. Once processed, your official transfer evaluation will be signed by your major advisor and placed in your file with the CmpE Department.
CmpE Policies Regarding Disqualification, Reinstatement, and Repeating Courses

Disqualification in the Major

Disqualified students to see the Chair for reinstatement.

Repeating courses for Academic Renewal
For academic renewal students need to follow the university policy, which can be found at:

http://www.sjsu.edu/senate/s00-10.htm

(At the time of adding the course, students must obtain the course instructor’s signature on the Academic Renewal form. At the department’s discretion, the student may be given a lower priority (S97-1) for adding the course than students attempting to add the class for the first time)

Reinstatement after Academic Disqualification

From the SJSU Catalog (2004-2006; page 444)

Reinstatement and Readmission of Undergraduate Students after Academic Disqualification. In all cases, permission of the major department is required for reinstatement to that major.
Requirements for B.S. Degree
(Total of 133 Semester Units)

General Education .................................................................33
   Lower Division
   Upper Division

Physical Education .................................................................2

Preparation for the Major .........................................................29
   Math 30, 31, 32, 42, 133A
   Phys 70, 71 (or 50, 51, 52)
   Chem 1A

Engineering Common Core .......................................................15
   CmpE 46, Engr 10, ME 20, EE 97, EE 98, ME 109 (or MatE 153)

Required Courses in Engineering .................................................45
   CmpE 101, 102, 110, 124, 125, 126, 127, 130, 131, 140, 142, 152,
   195A and 195B, EE 101, ISE 130, Math 129A (or Math 138 or Math
   143C)

Approved Upper Division Electives ..............................................9

Total ..................133
## Sample Four-Year Plan

*(Total minimum units required for degree is 133)*

### FRESHMAN YEAR: 33 units

<table>
<thead>
<tr>
<th>Fall</th>
<th>Units</th>
<th>Spring</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 30</td>
<td>3</td>
<td>Math 31</td>
<td>4</td>
</tr>
<tr>
<td>Chem 1A</td>
<td>5</td>
<td>Phys 70&lt;sup&gt;3&lt;/sup&gt;</td>
<td>4</td>
</tr>
<tr>
<td>Engr 10</td>
<td>3</td>
<td>ME 20</td>
<td>2</td>
</tr>
<tr>
<td>Engl 1A</td>
<td>3</td>
<td>Engl 1B</td>
<td>3</td>
</tr>
<tr>
<td>Oral Communications</td>
<td>3</td>
<td>Human Understanding &amp; Develop.</td>
<td>3</td>
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### SOPHOMORE: 34 Units

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<tr>
<th>Fall</th>
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<tbody>
<tr>
<td>Math 32</td>
<td>3</td>
<td>Math 133A</td>
<td>3</td>
</tr>
<tr>
<td>Phys 71&lt;sup&gt;3&lt;/sup&gt;</td>
<td>4</td>
<td>EE 98</td>
<td>3</td>
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<tr>
<td>Gen. Ed.</td>
<td>3</td>
<td>EE 97</td>
<td>1</td>
</tr>
<tr>
<td>Gen. Ed.</td>
<td>3</td>
<td>Gen. Ed.</td>
<td>3</td>
</tr>
<tr>
<td>Math 42</td>
<td>3</td>
<td>Gen. Ed.</td>
<td>3</td>
</tr>
<tr>
<td>Human Performance</td>
<td>1</td>
<td>CmpE 46</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Human Performance</td>
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*Passing Writing Skills Test (WST) is required before taking 100W*

### JUNIOR YEAR: 38 Units

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<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Math 129A or 138 or 143C</td>
<td>3</td>
<td>CmpE 102</td>
<td>3</td>
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<tr>
<td>CmpE 110</td>
<td>3</td>
<td>CmpE 125</td>
<td>3</td>
</tr>
<tr>
<td>CmpE 124</td>
<td>3</td>
<td>CmpE 127</td>
<td>3</td>
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<tr>
<td>CmpE 126</td>
<td>3</td>
<td>CmpE 130</td>
<td>3</td>
</tr>
<tr>
<td>ISE 130</td>
<td>3</td>
<td>CmpE 142</td>
<td>3</td>
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<tr>
<td>Engr 100W</td>
<td>3</td>
<td>CmpE 131</td>
<td>3</td>
</tr>
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<td>CmpE 101&lt;sup&gt;4&lt;/sup&gt;</td>
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<tr>
<td>EE 101&lt;sup&gt;5&lt;/sup&gt;</td>
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*All CmpE senior courses require the completion of ENGR 100W and Major Form on file*

### SENIOR YEAR: 28 Units

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<tbody>
<tr>
<td>CmpE 140</td>
<td>3</td>
<td>ME 109 or MatE 153</td>
<td>3</td>
</tr>
<tr>
<td>CmpE 152</td>
<td>3</td>
<td>CmpE195B</td>
<td>3</td>
</tr>
<tr>
<td>CmpE 195A</td>
<td>1</td>
<td>Approved Tech. Elec.</td>
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<tr>
<td>Approved Tech. Elec.</td>
<td>3</td>
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<tr>
<td>Adv. Gen. Ed.</td>
<td>3</td>
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</tr>
</tbody>
</table>

---

<sup>3</sup> Physics 50, 51, 52 can replace Physics 70, 71.

<sup>4</sup> Can earn credit for CmpE 101 by passing CmpE101 Exam with CR (Prerequisite for CmpE 126)

<sup>5</sup> Can earn credit for EE 101 by passing EE101 Exam with CR (Prerequisite for CmpE 124)
## General Education Checklist

### College of Engineering

#### General Education Checklist for Students Entering as *Freshmen* Only

### (A) American Studies Option

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Units</th>
<th>Comments</th>
<th>Suggested Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Studies 1A</td>
<td>6</td>
<td>Lower Div. Core</td>
<td>Fall of Sophomore year</td>
</tr>
<tr>
<td>American Studies 1B</td>
<td>6</td>
<td>Lower Div. Core</td>
<td>Spring of Sophomore year</td>
</tr>
<tr>
<td>English 1A</td>
<td>3</td>
<td>Lower Div. Core</td>
<td>Fall of Freshmen year</td>
</tr>
<tr>
<td>English 1B</td>
<td>3</td>
<td>Lower Div. Core</td>
<td>Spring of Freshmen year</td>
</tr>
<tr>
<td>Human Und. &amp; Dev. (E)</td>
<td>3</td>
<td>Lower Div. Core</td>
<td>Spring of Freshmen year</td>
</tr>
<tr>
<td>Oral Communications (A1)</td>
<td>3</td>
<td>Lower Div. Core</td>
<td>Fall of Freshmen year</td>
</tr>
<tr>
<td>Human Performance</td>
<td>1</td>
<td>Upper Div. Adv.</td>
<td>Fall of Sophomore year</td>
</tr>
<tr>
<td>Human Performance</td>
<td>1</td>
<td>Upper Div. Adv.</td>
<td>Spring of Sophomore year</td>
</tr>
<tr>
<td>Engr 100W (R)</td>
<td>3</td>
<td>Upper Div. Adv.</td>
<td>Fall of Junior year</td>
</tr>
<tr>
<td>Adv. GE: Self &amp; Society (S)</td>
<td>3</td>
<td>Upper Div. Adv.</td>
<td>Fall of Senior year</td>
</tr>
</tbody>
</table>

### (B) Humanities Honors Option (by Invitation)

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Units</th>
<th>Comments</th>
<th>Suggested Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humanities 1A</td>
<td>6</td>
<td>Lower Div. Core</td>
<td>Fall of Freshmen year</td>
</tr>
<tr>
<td>Humanities 1B</td>
<td>6</td>
<td>Lower Div. Core</td>
<td>Spring of Freshmen year</td>
</tr>
<tr>
<td>Humanities 2A</td>
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<td>Humanities 2B</td>
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<td>Lower Div. Core</td>
<td>Spring of Sophomore year</td>
</tr>
<tr>
<td>Human Performance</td>
<td>1</td>
<td>Upper Div. Adv.</td>
<td>Fall of Sophomore year</td>
</tr>
<tr>
<td>Human Performance</td>
<td>1</td>
<td>Upper Div. Adv.</td>
<td>Spring of Sophomore year</td>
</tr>
<tr>
<td>Engr 100W (R)</td>
<td>3</td>
<td>Upper Div. Adv.</td>
<td>Fall of Junior year</td>
</tr>
</tbody>
</table>

### Note:

1. Upper division General Education (GE) courses are not transferable.
2. Students must pass the Writing Skills Test (WST) before taking upper division General Education.
3. Engineering students must satisfy the Mathematics and Science requirements of General Education (GE) through the courses taken for the major. Both plans in (A) and (B) above satisfy the rest of the lower division GE requirements.
4. Both plans in (A) and (B) also satisfy the American Institutions requirements.
College of Engineering
General Education Checklist for Transfer Students

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Units</th>
<th>Comments</th>
<th>Suggested Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 1A</td>
<td>3</td>
<td>Lower Div. Core</td>
<td>Fall of Freshmen year</td>
</tr>
<tr>
<td>English 1B</td>
<td>3</td>
<td>Lower Div. Core</td>
<td>Spring of Freshmen year</td>
</tr>
<tr>
<td>Humanities (Art) (C1)</td>
<td>3</td>
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<td>Fall of Sophomore year</td>
</tr>
<tr>
<td>Humanities (Letters) (C2)</td>
<td>3</td>
<td>Lower Div. Core</td>
<td>Spring of Sophomore year</td>
</tr>
<tr>
<td>Social Science (D1) Human Behavior</td>
<td>3</td>
<td>Lower Div. Core</td>
<td>Spring of Freshmen year</td>
</tr>
<tr>
<td>Social Science (D2) Comp. Systems</td>
<td>3</td>
<td>Lower Div. Core</td>
<td>Fall of Sophomore year</td>
</tr>
<tr>
<td>Social Science (D3) Social Issues</td>
<td>3</td>
<td>Lower Div. Core</td>
<td>Spring of Sophomore year</td>
</tr>
<tr>
<td>Human Und. &amp; Dev. (E)</td>
<td>3</td>
<td>Lower Div. Core</td>
<td>Spring of Freshmen year</td>
</tr>
<tr>
<td>Oral Communications (A1)</td>
<td>3</td>
<td>Lower Div. Core</td>
<td>Fall of Freshmen year</td>
</tr>
<tr>
<td>Human Performance</td>
<td>1</td>
<td>Upper Div. Adv.</td>
<td>Fall of Sophomore year</td>
</tr>
<tr>
<td>Human Performance</td>
<td>1</td>
<td>Upper Div. Adv.</td>
<td>Spring of Sophomore year</td>
</tr>
<tr>
<td>Engr 100W (R)</td>
<td>3</td>
<td>Upper Div. Adv.</td>
<td>Fall of Junior year</td>
</tr>
<tr>
<td>Adv. GE: Self, Society and Equality (S)</td>
<td>3</td>
<td>Upper Div. Adv.</td>
<td>Fall of Senior year</td>
</tr>
</tbody>
</table>

Notes:
1. Upper division General Education (GE) courses are not transferable.
2. Students must pass the Writing Skills Test (WST) before taking upper division General Education.
3. For Social Science D2-D3, students should take one of the following sequences in order to satisfy the American Institutions requirement:
   a. History/Political Science 15A-15B
   b. Afro-American Studies 2A-2B
   c. Asian American Studies 33A-33B
4. Students who have taken the Social Science D2-D3 at the community college should make sure that these courses also satisfy the American Institutions requirement.
5. Students who have completed the IGETC or CSU BREADTH programs at community college receive full credit for lower division General Education (GE). Students who have not completed either of these programs must satisfy the 27-unit core lower division requirement given above. Individual courses within this requirement can be satisfied by courses taken at community college.
6. Engineering students satisfy the Mathematics and Science requirements of General Education through courses taken for the major. The courses listed above satisfy the remainder of lower division General Education.
# Major Form for Program Starting

**Fall 2004 and Spring 2005**

SAN JOSE STATE UNIVERSITY, COMPUTER ENGINEERING DEPARTMENT

BACHELOR OF SCIENCE IN COMPUTER ENGINEERING

<table>
<thead>
<tr>
<th>Last Name</th>
<th>First Name</th>
<th>M.I.</th>
<th>Student ID</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total number of units for degree: 133

Program start semester/year (select one)  
Fall 2004 [ ] Spring 2005 [ ]

Proposed semester of graduation: ________

## Engineering Common Core (Totals 15 units)

<table>
<thead>
<tr>
<th>Dept</th>
<th>No.</th>
<th>Title</th>
<th>Units</th>
<th>Grade</th>
<th>Dept</th>
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<th>Units</th>
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</thead>
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<td>Computer Engineering I</td>
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<td>ME</td>
<td>109</td>
<td>Heat Transfer in Electronics</td>
<td>3</td>
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<tr>
<td>Engr</td>
<td>10</td>
<td>Introduction to Engineering</td>
<td>3</td>
<td>EE</td>
<td>97</td>
<td>Introduction to EE Laboratory</td>
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</tr>
<tr>
<td>ME</td>
<td>20</td>
<td>Design &amp; Graphics</td>
<td>2</td>
<td>EE</td>
<td>98</td>
<td>Introduction to Circuit Analysis</td>
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## Required Courses (Totals 48 units)

<table>
<thead>
<tr>
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<th>No.</th>
<th>Title</th>
<th>Units</th>
<th>Dept</th>
<th>No.</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CmpE</td>
<td>101</td>
<td>Prog. Concepts &amp; Problem Solving</td>
<td>1</td>
<td>CmpE</td>
<td>140</td>
<td>Computer Architecture &amp; Design</td>
<td>3</td>
</tr>
<tr>
<td>CmpE</td>
<td>102</td>
<td>Assembly Programming</td>
<td>3</td>
<td>CmpE</td>
<td>142</td>
<td>Operating Systems Design</td>
<td>3</td>
</tr>
<tr>
<td>CmpE</td>
<td>110</td>
<td>Introduction to Digital Electronics</td>
<td>3</td>
<td>CmpE</td>
<td>152</td>
<td>Compiler Design</td>
<td>3</td>
</tr>
<tr>
<td>CmpE</td>
<td>124</td>
<td>Digital Design I</td>
<td>3</td>
<td>CmpE</td>
<td>195A</td>
<td>CmpE Senior Design I</td>
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<tr>
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<td>125</td>
<td>Digital Design II</td>
<td>3</td>
<td>CmpE</td>
<td>195B</td>
<td>CmpE Senior Design II</td>
<td>3</td>
</tr>
<tr>
<td>CmpE</td>
<td>126</td>
<td>Algorithm &amp; Data Structure Design</td>
<td>3</td>
<td>EE</td>
<td>101</td>
<td>Circuit Concepts &amp; Problem Solving</td>
<td>1</td>
</tr>
<tr>
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<td>127</td>
<td>Microprocessor Design I</td>
<td>3</td>
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<td>100W</td>
<td>Engineering Reports</td>
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<td>CmpE</td>
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<td>File Processing</td>
<td>3</td>
<td>ISE</td>
<td>130</td>
<td>Engineering Probability &amp; Statistics</td>
<td>3</td>
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<tr>
<td>CmpE</td>
<td>131</td>
<td>Software Engineering I</td>
<td>3</td>
<td>Math</td>
<td>129A</td>
<td>Linear Algebra I</td>
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## Technical Electives (Totals 9 units)

## Courses Required in Preparation for the Major Mathematics, Chemistry, Physics (Totals 29 units)

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<th>Units</th>
<th>Dept</th>
<th>No.</th>
<th>Title</th>
<th>Units</th>
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<td>3</td>
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<tr>
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<td>Phys</td>
<td>70</td>
<td>Mechanics</td>
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<tr>
<td>Math</td>
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<td>Calculus III</td>
<td>3</td>
<td>Phys</td>
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<td>Electricity &amp; Magnetism</td>
<td>4</td>
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<td>Discrete Mathematics</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Math</td>
<td>133A</td>
<td>Ordinary Differential Equations</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Signature of student

will have completed all the requirements for the Bachelor of Science in Computer Engineering after:

a) Successful completion of the above work.
b) An audit of the student’s transcript of record to verify that all appropriate data has been entered accurately.
c) A minimum 2.0 GPA in all REQUIRED COURSES has been achieved.
d) A minimum 2.0 GPA in all REQUIRED COURSES and TECHNICAL ELECTIVES combined has been achieved.
e) A minimum 2.0 GPA in all REQUIRED COURSES and TECHNICAL ELECTIVES taken at SJSU has been achieved.

Signature of Major Advisor

Date

Signature of CmpE Department Chair

Date

Appendix III – Program Profile

III-15
SUBSTITUTION OF COURSE IN MAJOR FORM

COLLEGE OF ENGINEERING
SAN JOSE STATE UNIVERSITY

(to be used for making changes on approved major forms)

NAME:__________________________ DATE:___________________________

MAJOR:_________________________ SSN:____________________________

PROPOSED DATE OF GRADUATION:__________________

ADD THE FOLLOWING COURSES

<table>
<thead>
<tr>
<th>UNIV./COLLEGE</th>
<th>COURSE</th>
<th>TITLE</th>
<th>UNITS (Qtr/Sem)</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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</table>

DELETE THE FOLLOWING COURSES

<table>
<thead>
<tr>
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<th>COURSE</th>
<th>TITLE</th>
<th>UNITS (Qtr/Sem)</th>
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</tbody>
</table>

Approved by:_____________________________________
Major Advisor

<table>
<thead>
<tr>
<th>Department Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
</tr>
</tbody>
</table>
# Major Advising Form for B. S. in Computer Engineering

**Curriculum for Fall 2004, Spring 2005**

<table>
<thead>
<tr>
<th>Last Name</th>
<th>First Name</th>
<th>M.I.</th>
<th>Student ID</th>
<th>Semester/Year followed (check one)</th>
<th>Phone Number</th>
<th>Email Address</th>
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</thead>
</table>

<table>
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<th>Remarks</th>
<th>Math 31</th>
<th>4</th>
<th>Grade</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td>Chem 1A</td>
<td>5</td>
<td></td>
<td></td>
<td>Phys 70/50*</td>
<td>4</td>
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</tr>
<tr>
<td>Engr 10</td>
<td>3</td>
<td></td>
<td></td>
<td>ME 20</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engl 1A</td>
<td>3</td>
<td></td>
<td></td>
<td>Engl 1B</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral Comm</td>
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<td></td>
<td>HU&amp;D</td>
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<tr>
<td>Phys 71/51*</td>
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<td>Phys 52*</td>
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</tr>
<tr>
<td>CmpE 124</td>
<td>3</td>
<td></td>
<td></td>
<td>CmpE 127</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CmpE 126</td>
<td>3</td>
<td></td>
<td></td>
<td>CmpE 130</td>
<td>3</td>
<td></td>
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</tr>
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<td>CmpE 110</td>
<td>3</td>
<td></td>
<td></td>
<td>CmpE 142</td>
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<td>ISE 130</td>
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<td>CmpE 102</td>
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<td>CmpE 131</td>
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<td>CmpE 101</td>
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<td></td>
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</tbody>
</table>

| CmpE 140  | 3          |       |         | ME109     | 3          |       |         |
| CmpE 195A | 1          |       |         | CmpE 102B | 3          |       |         |
| CmpE 152  | 3          |       |         | Tech Elec.| 3          |       |         |
| Tech Elec.| 3          |       |         | Adv. GE   | 3          |       |         |
| Adv. GE   | 3          |       |         |           |            |       |         |

*Phys 50, 51 & 52 alternate series for Phys 70 & 71  ** MatE 153 alternate course for ME 109

Advisor Name:  

Advising Date:  

Submit major form (Use form applicable to curriculum for Fall 2004, Spring 2005)

---

Appendix III – Program Profile
B.S. in Computer Engineering Advance Registration Form

Admission Date: ______________________________
CmpE Student Guide Date: ____________________

________________________________     ___________________  ______ SID: _____-_____-_____
(Last Name)                                                (First Name)                          (MI)
________________________________     _____________________________
(Phone Number)    (Email address)

I request approval to enroll in the following for ________________ semester.

I plan to work part time _____ hrs per week  or      full time _____ hrs,
while taking classes.

<table>
<thead>
<tr>
<th>Department</th>
<th>Number</th>
<th>Units</th>
<th>Prerequisites or Corequisites (CmpE courses only) *</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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</tr>
</tbody>
</table>

Total Units: _______ (Maximum 18 units)

I certify that, to my best knowledge, I will (1) have completed all prerequisites of the above engineering courses before taking them, and (2) take all corequisites at the same time or have taken all corequisites before taking the above Engineering courses. I understand that I will either be dropped by the instructor or get a failure grade if I take a course without satisfying both of the above conditions. I further certify that I have not taken any of these courses twice in the past.

Student signature____________________________ Date_____________________

Advisor signature____________________________ Date_____________________