Program Performance Review

Self-Study Report

Master of Science
in
Computer Engineering

California State University, Fullerton

March 2019

I. *Department/Program Mission, Goals and Environment*

A. Mission and goals of the Computer Engineering Program and the relation to the university mission, goals and strategies

The Computer Engineering Program is committed to providing students with a strong theoretical and practical understanding in both the hardware and software aspects of computer-based systems, along with the engineering analysis, design, and implementation skills necessary to solve problems using computer engineering principles and techniques. The program prepares students for productive, dynamic, and rewarding careers in computer engineering and for advanced studies and research in computer engineering and related disciplines.

The Computer Engineering Program has established the following Program Educational Objectives (PEOs):

1. **Technical Growth:** Graduates will be successful in modern engineering practice, integrate into the local and global workforce, and contribute to the economy of California and the nation.
2. **Professional Skills:** Graduates will continue to demonstrate the professional skills necessary to be competent employees, assume leadership roles, and enjoy career success and satisfaction.
3. **Professional Attitude and Citizenship:** Graduates will become productive citizens with high ethical and professional standards, make sound engineering or managerial decisions, and have enthusiasm for the profession and professional growth.

The Computer Engineering Program also has established the following student outcomes. Upon completion of the degree program, graduates of the Computer Engineering program must demonstrate:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. Aan ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

B. Changes and trends in the discipline and the response of the program to such changes

According to the Global Market Insights, worldwide computer engineering market size is estimated to surpass USD 2.5 trillion by 2024. We are in an era of advanced connected technologies such as artificial intelligence, mobile computing applications and IoT. Therefore, the design, manufacturing, and deployment of computer systems have changed in many ways. From being a purely hardware-oriented space to having evolved as a business establishing its presence across numerous other application sectors, computer engineering market has indeed come a long way. Moreover, this has encouraged core companies to brainstorm newer innovations that could potentially change the dynamics of the future industry. To not fall behind and keep up with the trend, the computer engineering program has been striving to hire new faculty members. The program has successfully hired one more new faculty in this academic year. The program's effort in finding new faculty will result in various new courses that employ the current trend of computer engineering field and this will definitely benefit the graduate students in learning the emerging topics and preparing better for their future career as a professional engineer. In addition to hiring new faculty, the program has acquired new hardware boards in place of the outdated boards in order to give better hands-on experience to students. With new boards and equipment that we already have, students can learn from not only theories and concepts but also practical project/research experiences.

C. Computer Engineering Program's priorities for the future

The Computer Engineering Program will prepare graduate students to become a professional engineer who can jump right into any area of computer engineering and work creatively to produce quality outcomes. This will be possible because the program is continuously developing new courses based on the recent technology trend and developments. We will always focus on integrating the state-of-the art technologies and practices in computer engineering into the graduate program. Any necessary curriculum change will be made based on the trends of technology improvement and demand in the job market.

D. There are no programs currently offered in a Special Session self-support mode in the Computer Engineering Program.

II. *Department/Program Description and Analysis*

A. This is the first Program Performance Review (PPR) for the MS program in Computer Engineering. Therefore, there have been no substantial changes from the last review.

B. Structure of the MS degree program and identification of the logic underlying the organization of the requirements

Over the past decade, there has been a rapid increase in demand for computer engineers in various fields ranging from the area of mobile devices (iPad, iPhone, etc.) to high-performance computing systems needed for e-prescription and electronic health record keeping. This trend only continues to grow.

The program is committed to providing exciting academic programs. It strives to combine the best facilities along with a driven faculty and an innovative curriculum to prepare students for the great engineering challenges of the 21st century.

The MS degree program in Computer Engineering is designed to provide students with a strong understanding of the hardware design and practical applications of computer-based systems. Students in the program must complete all the requirements for the MS degree with a total of 30 semester units. The courses in contemporary and highly evolving computer engineering areas provide students with extensive hardware design and modeling experience, exposure to state-of-the-art electronic design automation (EDA) tools and the ability to design and analyze today's modern computer systems. Students are also encouraged to take courses from the graduate program in Computer Science and key courses in Electrical Engineering to expand their background. After completion of the degree program, graduates will have extensive theoretical knowledge and practical background in all aspects of computer-based systems, along with an in-depth knowledge in engineering analysis, design, implementation and testing. The program will prepare students for engineering jobs that require computer hardware skills.

The Master's degree program in Computer Engineering is open to students who have earned a bachelor's degree in computer engineering or a related discipline.

General Requirements

At the time of admission into the M.S. program, students should:

1. Have completed a four-year college course of study and hold an undergraduate degree in computer engineering or a related discipline from

an ABET accredited institution, or from an institution accredited by a regional accrediting association;
2. Be in good academic standing at the last college or university attended; and
3. Have attained a minimum grade point average (GPA) of 2.5 in cumulative or the last 60 semester units (90 quarter units). A GPA of 3.0 is required of students whose Bachelor's degree is from a non-ABET accredited university or if the Bachelor's degree is in an area other than engineering or computer science.

Additional Information for International Students

In addition to meeting the general admission requirements, international students from countries where English is not the native language should have a minimum valid TOEFL score as noted below:

- 80 on the Internet Based TOEFL (IBT), or
- 550 on the Paper Based TOEFL (PBT)

The TOEFL score should be directly reported to California State University, Fullerton (ETS Institution Code: 4589). Alternatively, the following are also acceptable to meet this requirement:

- A minimum International English Language Testing System (IELTS) score of 6.5, or
- A minimum PTE score of 58

In order to obtain the M.S. degree in Computer Engineering, a student must complete 30 semester units of coursework beyond the Bachelor's degree, which will be included in a formal Study Plan.

Residence Requirement

A minimum of 21 semester units required by the program must be taken in residence at California State University, Fullerton. Residence units are granted for courses taken at the University during regular sessions of fall and spring and any special session.

Classified Graduate Standing

A student will obtain the status of Classified Graduate Standing upon the fulfillment of the following requirements:

1. Approval of a formal Study Plan by the Computer Engineering Graduate Advisor or the Program Coordinator and the Office of Graduate Studies;
2. Satisfactory completion of no more than 13 units on the Study Plan;
3. Fulfillment of the University writing requirement.

University Writing Requirement

The University writing requirement can be met by obtaining a passing score on the California State University Examination in Writing Proficiency (EWP) exam. A score of 4.0 or more on the GRE Analytical Writing section is also acceptable for meeting the University writing requirement.

The University writing requirement must be satisfied before the student can be classified. Students who fail to pass the EWP test may complete ENGL 301 or ENGL 360 or TESL 301 with a "C" (2.0) or better as an alternative to the EWP requirement.

Study Plan

Prior to the completion of 13 units towards the M.S degree requirements, the student must meet with the graduate advisor and develop a formal Study Plan. The latest version of the CpE Study Plan template can be obtained from the Computer Engineering website or from the CpE Program office.

The Study Plan must be approved by the Computer Engineering graduate advisor or the program coordinator and the Office of Graduate Studies. Courses taken towards meeting the undergraduate degree requirements cannot be used towards the Graduate Study Plan.

Changes in Study Plan

If a classified graduate student needs to make a change in the approved Study Plan, a request should be made to the student's departmental Graduate Program Advisor. Requests must be made prior to registration for any coursework to be substituted or added. No course may be removed from the Study Plan after a student has taken it. Forms which may be used to file a request for change in Study Plan are available in the Graduate Studies Office, or on the Graduate Studies website.

Communication of Policies, Procedures and Deadlines

CpE graduate students may receive communication from various individuals and/or campus offices regarding various policies, procedures and deadlines pertaining to graduate students. These include, but are not limited to, the CpE Program office, graduate advisor, program coordinator, Office of Graduate Studies, members of the CpE graduate committee, ECS Dean's office, Admissions and Records (A&R), and International Program and Global Engagement (IPGE). The modes of communication may include emails, memos, letters or phone calls. CpE graduate students are expected to follow instructions and follow up on such communication in a timely manner.

Core Courses

Out of the 30 semester units required for the M.S degree, 18 units must be comprised of required core courses. These courses are listed below:
1. EGCP 456 – Introduction to Logic Design in Nanotechnology (3 units)
2. EGCP 461 – Low Power Digital IC Design (3 units)
3. EGCP 520 – Advanced Computer Architecture (3 units)
4. EGCP 541 – Mixed-Signal IC Design (3 units)
5. EGCP 542 – VLSI Testing and Design for Testability (3 units)
6. EGCP 556 – Advanced Nanoelectronics (3 units)

Approved Technical Elective Courses

The technical electives shall constitute a coherent body of study consistent with the student's professional and educational objectives.

The number of electives to be taken depends upon the culminating experience option, as explained below:

Option 1 (Comprehensive Exam): Students who wish to take the comprehensive exam option must take 12 units of advisor approved elective courses. At least 9 of these 12 units must be at the 500-level.

Option 2 (Project): Students who wish to take the Project option must, in addition to the Project (*EGCP 597:3 units*), take 9 units of advisor approved elective courses. At least 6 of these 9 units must be at the 500-level.

Option 3 (Thesis): Students who wish to take the Thesis option must, in addition to the Thesis (*EGCP 598:6 units*), take 6 units of advisor approved elective courses. At least 3 of these 6 units must be at the 500-level.
A list of approved elective courses is given below. Course designations are as follows: CPSC for computer science courses, EGCP for computer engineering courses, and EGEE for electrical engineering courses.

The CpE program may offer, from time to time, additional CpE elective courses that are not listed here. Information about these courses may be obtained from the CpE program office.

Prerequisites for electives: Prior to enrolling in any approved elective course, CpE graduate students are urged to ensure that they meet all the prerequisite requirements for that course. It is the student's responsibility to ensure that he/she has the background knowledge and preparation required to enroll and successfully complete the course.

Course No.		*Units*
	Wireless Communication	
EGEE 443	Electronic Communication Systems	3
EGEE 460	Introduction to Cellular Mobile Communications Systems	3
EGEE 522	Spread Spectrum Communications	3
EGEE 537	Satellite Communications	3
	Computer Communication and Networks	
CPSC 471	Computer Communications	
CPSC 558	Advanced Computer Networking	3
	Very Large Scale Integration (VLSI) and Optics	
EGCP 446	Advanced Digital Design using Verilog HDL	3
EGEE 410	Electro-Optical Systems	3
EGEE 455	Microelectronics and Nano Devices	3
EGEE 465	Introduction to VLSI Design	3
EGEE 480	Optical Engineering and Communications	3
EGEE 510	Optics & Electromagnetics in Communications	3
EGEE 523A	VLSI and Nano Technology and Devices	3
EGEE 523B	CMOS VLSI Design	3
	Hardware Security	
EGCP 447	Introduction to Hardware Security and Trust	3
EGCP 543	Advanced Secure Hardware Design	3
	Software Security	
CPSC 452	Cryptography	3
CPSC 454	Cloud Computing and Security	3
CPSC 456	Network Security Fundamentals	3
	Microprocessors and Microcomputer Systems	
EGEE 404	Introduction to Microprocessors and Microcomputers	3
EGEE 406	Design Applications with Microcontroller and FPGA	3
EGEE 557	Microprogramming and Embedded Microprocessors	3
EGEE 558A	Microprocessors and System Applications I	3
EGEE 558B	Microprocessors and System Applications II	3
	Control Systems and Systems Engineering	
EGEE 416	Feedback Control Systems	3
EGEE 424	Computer Simulation of Continuous Systems	3
EGEE 518	Digital Signal Processing	3
EGEE 526	Digital Control Systems	3
EGEE 580	Analysis of Random Signals	3
EGEE 559	Introduction to Robotics	3
	Global Positioning Systems (GPS)	
EGEE 483	Introduction to Global Positioning Systems	3
	System Software	
CPSC 451	Advanced Operating Systems	3
CPSC 477	Introduction to Grid Computing	3
CPSC 551	Operating Systems Design	3
CPSC 462	Software Design	3

	Software Engineering	
CPSC 463	Software Testing	3
CPSC 464	Software Architecture	3
CPSC 466	Software Process	3
CPSC 541	Systems and Software Standards and Requirements	3
CPSC 542	Software Verification and Validation	3
CPSC 543	Software Maintenance	3
CPSC 544	Advanced Software Process	3
CPSC 545	Software Design and Architecture	3
CPSC546	Modern Software Management	3
CPSC 547	Software Measurement	3
	Database System Design	
CPSC 431	Database and Applications	3
CPSC 474	Parallel and Distributed Computing	3
CPSC 531	Advanced Database Management	3
	Multimedia and Digital Game Development	
CPSC 484	Principles of Computer Graphics	3
CPSC 486	Game Programming	3
CPSC 489	Game Development Project	3
CPSC 566	Advanced Computer Graphics	3
	Software Application Development	
CPSC 411	Mobile Device Application Programming	3
CPSC 473	Web Front-End Engineering for Internet Applications	3
	Intelligent Systems	
CPSC 476	Web Back-End Engineering for Enterprise Applications	3
CPSC 481	Artificial Intelligence	3
CPSC 483	Data Mining and Pattern Recognition	3
CPSC 583	Expert Systems Design Theory	3
CPSC 585	Artificial Neural Networks	3
	Others	
EGCP 463	Current Topics in Computer Engineering	3
EGCP 599	Independent Graduate Research	1-3
	Graduate Project and Thesis	
EGCP 597	Graduate Project	3
EGCP 598	Graduate Thesis	6

Culminating Experience

The culminating experience can be met through of any one of the following options: Comprehensive Examination, Project, or Thesis. These culminating experience options are outlined below:

Option 1 (Comprehensive Examination):
This option requires 18 units of core courses, 12 units of approved elective courses (out of which, a maximum of 3 units may be at 400-level), and the culminating experience met through a comprehensive examination.

Option 2 (Project):
This option requires 18 units of core courses, 9 units of approved elective courses (out of which, a maximum of 3 units may be at 400-level) and the culminating experience met through 3 units of Project.

The Project (*EGCP 597*) course is designed to replicate a full spectrum of design processes that are involved in a medium-sized computer engineering project in the industry. The experience includes a creative design effort with realistic socio economic constraints and development of skills such as feasibility study, project planning, design formulation, time budgeting, task division among team members, oral, written and visual communication to document and disseminate the design adequately to others. The project requires students to think independently, research and brainstorm different project concepts before settling on a project that meets several criteria set forth by the Computer Engineering program. Students are provided with systematic faculty guidance during the project to ensure a well-rounded experience.

To enroll in the Project, a student must have Classified Graduate Standing. Before enrolling in the Project, a Project Proposal must be submitted to the Computer Engineering Program office no later than the last day of instruction of the semester preceding the semester in which the student plans to enroll for the Project. This form must be signed by a supervising full-time faculty member and by a second faculty reviewer.

The Project option requires the presentation of project work and a question-and-answer session before the supervising faculty member and one or more members of the CpE program graduate committee.

Option 3 (Thesis):
This option requires 18 units of core courses, 6 units of approved elective courses (out of which, a maximum of 3 units may be at 400-level), and the culminating experience met through 6 units of Thesis.

To enroll in the Thesis (*EGCP 598*), a student must have Classified Graduate Standing. The student shall first choose a faculty advisor and then, in consultation with the faculty advisor, choose a thesis committee consisting of three faculty members, including the faculty

advisor. The thesis should cover original research and be prepared according to the university guidelines. The thesis committee will judge the research competence of the student during the thesis defense. The student is also required to complete an oral defense, a demo and a final thesis report by the deadlines set for the spring semester of the fourth year. Thesis defense is announced in advance and open to the university community.

Before enrolling in the Thesis, a Thesis proposal must be submitted to the Computer Engineering Program office no later than the last day of instruction of the semester preceding the semester in which the student plans to enroll for the Thesis. This form must be signed by a supervising full-time faculty member and by a second faculty reviewer.

C. Student demand for the program's offerings in relation to over-enrollment, under-enrollment, and graduation rate

The trend of application and enrollment in the MS Program in Computer Engineering is shown in the table below. Based on the table, despite the constant number of applied students, enrolled rate has decreased over time. One of the main reasons behind the reduced number of enrolled students is the difficulty in obtaining their student visa as most of the students are from international countries such as India and China.

Full-Time Equivalent Students (FTES) and Headcount in academic year 2017-2018 also have increased significantly from the very first year of the graduate program in academic year of 2013-2014. When the MS program first started, each graduate class experienced over-enrollment due to a sudden growth in student number. However, the program has continuously hired new faculty members in recent years, and as a result, the enrollment in each class has been decreased to manageable size of 20-30 students.

The number of MS degree awarded has continuously increased to 106 in the academic year of 2016-2017. This growth compared to the first graduation rate is by 106 times.

Table II-1. Graduate Program Applications, Admissions, and Enrolled

AY	applied	admitted	enrolled
2013-2014	51	36	17
2014-2015	416	346	183
2015-2016	278	172	82
2016-2017	230	186	66
2017-2018	245	152	57

Table II-2. Graduate Program Enrollment in FTES

AY	FTES
2013-2014	2.0
2014-2015	38.1
2015-2016	77.1
2016-2017	71.3
2017-2018	51.9

Table II-3. Graduate Program Enrollment in Headcount

AY	headcount	FTES per HC
2013-2014	18	0.3
2014-2015	199	0.3
2015-2016	237	0.5
2016-2017	232	0.4
2017-2018	189	0.4

Table II-4. Master's Degree Awarded

AY	Degrees Awarded
2014-2015	1
2015-2016	42
2016-2017	106

D. Program's enrollment trends based on FTES, faculty allocation, and student faculty ratios

Based on the below Table II-5, Full Time Equivalent Faculty (FTEF) has increased by 133% in six years, and actual Full Time Equivalent Student has also increased by 2,495% during the same time period. Student to faculty ratio is about 7.4 which is already in the acceptable range. However, the program hired one more faculty for AY 2018-2019 and one more has been recently hired for upcoming AY 2019-2020. Therefore, the student to faculty ratio will be improved further.

Table II-5. Faculty Composition

AY	Tenured	Tenure Track	Sabbatical	FERP	Lecturer	FTEF	AYFTES
2013-2014	1	2	0	0	0	3	2.0
2014-2015	1	3	0	0	0	4	38.4

2015-2016	2	3	0	0	0	5	77.1
2016-2017	2	6	0	0	0	8	71.7
2017-2018	3	4	0	0	0	7	51.9

E. Plans for curricular changes in the short (3-year) and long (7-year) term

Since 2014, the program has hired five faculty members which takes 62.5% of the total number of full-time faculty composition. As a result, the programs has been offering various special coursed to provide students with a new set of courses in emerging fields of computer engineering. The special courses that have been offered so far are as follows:

- EGCP 548: Real-Time Audio Processing
- EGCP 549: Hardware Design and Acceleration for Image Processing
- EGCP 565: Rapid Prototyping for Internet of Things (IoT)
- EGCP 570: Introduction to Digital VLSI Logic Design and Computer Organization

The above special courses will be offered up to four times and placed in the curriculum as permanent technical electives.

In AY 2019-2020, one more faculty member will join the program and the FTEF will increase further. Therefore, the program will continuously develop new special courses with the help of new faculty members as their specialties are different. This effort will provide the graduate students with new aspects of emerging technologies in the field of computer engineering.

Moreover, the program is currently seeking a collaboration with the business department to give the students a chance to employ entrepreneurship in their engineering projects. This effort will provide the students with a new perspective as an engineer.

F. There are no special sessions to be offered by the Computer Engineering Program in the future.

III. *Student Academic Achievement and Assessment of Student Learning Outcomes*

A. Program assessment plan and structure

For the MS program in computer engineering, assessment of student learning outcomes has been performed every academic year starting AY 2015-2016. A graduate course is chosen by the program coordinator for each student learning outcome and direct assessment is conducted based on students' homework

assignments, projects or exams. A specific set of rubrics is used to assess each and every student's performance in the corresponding course.

B. Student learning outcomes and description of methods used to measure student learning; summary of assessment results

The student learning outcomes and the rubrics for the assessment are as follows:

Student Learning Outcomes:

1. SLO 1: An ability to apply knowledge of advanced mathematics, science and engineering
2. SLO 2: Ability to communicate effectively
3. SLO 3: An ability to used the techniques, skills and modern engineering tools necessary for engineering practice

Rubrics:

- Minimal: 10
- Basic: 15
- Proficient: 20
- Advanced: 25

Assessment results are provided below as an example of how each student learning outcome is assessed from a selected graduate course. The assessment results were collected from EGCP 556: Advanced Nanoelectronics in Spring 2017 by using one of the homework assignments to assess the SLO 3.

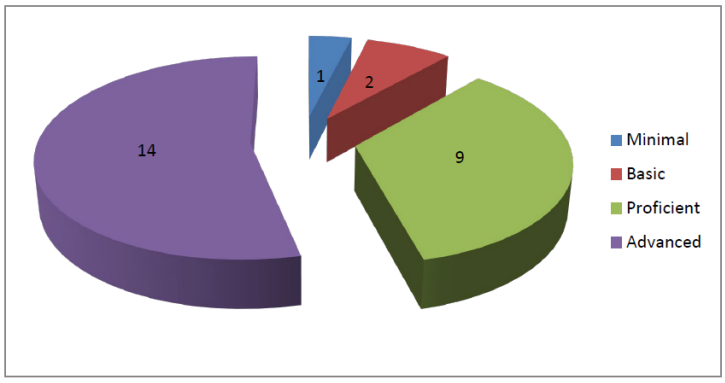
Analysis: Rubric to Assess Student Learning Outcome (3)
Course: ECGP-556-04 - Spring 2017 - Assignment 4 - CNTFET Analysis using Hspice
Intended Outcome: An ability to use the techniques, skills and modern engineering tools necessary for engineering practice
Mininal (10), Basic (15), Proficient (20), Advanced (25)

First Name	Last Name	*(1) Assignment Identified / Clarified*	*(2) Calculations and Simulations Performed*	*(3) Correct Result*	*(4) Justification of Anaysis*	*Result with*	*Total score*	*Letter Grade*
Student	1	25	20	25	20		90	A
Student	2	25	20	25	20		90	A
Student	3	20	20	20	20		80	B
Student	4	25	25	25	25		100	A
Student	5	25	20	25	20		90	A
Student	6	15	15	15	15		60	D
Student	7	25	25	25	25		100	A
Student	8	20	20	20	20		80	B
Student	9	25	20	25	20		90	A
Student	10	25	20	25	20		90	A
Student	11	20	20	20	20		80	B
Student	12	25	25	25	25		100	A
Student	13	25	25	25	25		100	A
Student	14	20	20	20	20		80	B
Student	15	25	25	25	25		100	A
Student	16	20	20	20	20		80	B
Student	17	10	10	10	10		40	F
Student	18	20	20	20	20		80	B
Student	19	20	20	20	20		80	B
Student	20	20	20	20	20		80	B
Student	21	15	15	15	15		60	D
Student	22	25	25	25	20		95	A
Student	23	25	25	25	20		95	A
Student	24	20	20	20	20		80	B
Student	25	25	25	25	25		100	A
Student	26	25	25	25	20		95	A

Analysis: Rubric to Assess Student Learning Outcome (3)
Course: ECGP-556-04 - Spring 2017 - Assignment 4 - CNTFET Analysis using Hspice
Intended Outcome: An ability to use the techniques, skills and modern engineering tools
Mininal (10), Basic (15), Proficient (20), Advanced (25)

	(1) Assignment Identified / Clarified
Student 1	25
Student 2	25
Student 3	20
Student 4	25
Student 5	25
Student 6	15
Student 7	25
Student 8	20
Student 9	25
Student 10	25
Student 11	20
Student 12	25
Student 13	25
Student 14	20
Student 15	25
Student 16	20
Student 17	10
Student 18	20
Student 19	20
Student 20	20
Student 21	15
Student 22	25
Student 23	25
Student 24	20
Student 25	25
Student 26	25

Rubric Scale	*Count*
Minimal	1
Basic	2
Proficient	9
Advanced	14



Analysis: Rubric to Assess Student Learning Outcome (3)
Course: ECGP-556-04 - Spring 2017 - Assignment 4 - CNTFET Analysis using Hspice
Intended Outcome: An ability to use the techniques, skills and modern engineering tools necessary for
Mininal (10), Basic (15), Proficient (20), Advanced (25)

	(2) Calculations and Simulations Performed
Student 1	20
Student 2	20
Student 3	20
Student 4	25
Student 5	20
Student 6	15
Student 7	25
Student 8	20
Student 9	20
Student 10	20
Student 11	20
Student 12	25
Student 13	25
Student 14	20
Student 15	25
Student 16	20
Student 17	10
Student 18	20
Student 19	20
Student 20	20
Student 21	15
Student 22	25
Student 23	25
Student 24	20
Student 25	25
Student 26	25

Rubric Scale	*Count*
Minimal	1
Basic	2
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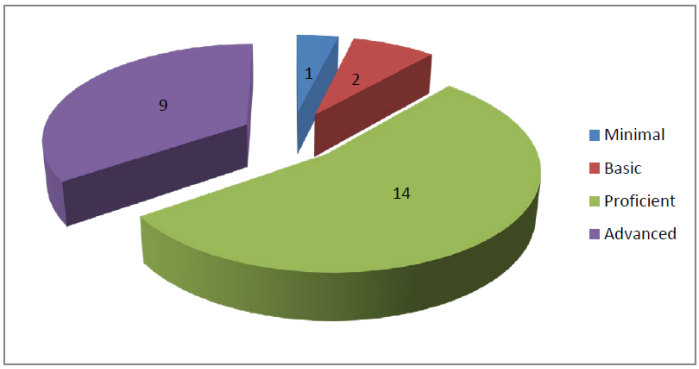

Analysis: Rubric to Assess Student Learning Outcome (3)
Course: ECGP-556-04 - Spring 2017 - Assignment 4 - CNTFET Analysis using Hspice
Intended Outcome: An ability to use the techniques, skills and modern
Mininal (10), Basic (15), Proficient (20), Advanced (25)

	(3) Correct Result
Student 1	25
Student 2	25
Student 3	20
Student 4	25
Student 5	25
Student 6	15
Student 7	25
Student 8	20
Student 9	25
Student 10	25
Student 11	20
Student 12	25
Student 13	25
Student 14	20
Student 15	25
Student 16	20
Student 17	10
Student 18	20
Student 19	20
Student 20	20
Student 21	15
Student 22	25
Student 23	25
Student 24	20
Student 25	25
Student 26	25

Rubric Scale	*Count*
Minimal	1
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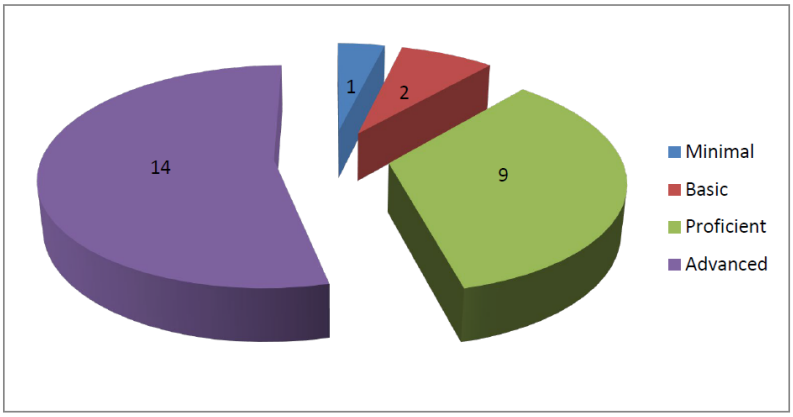
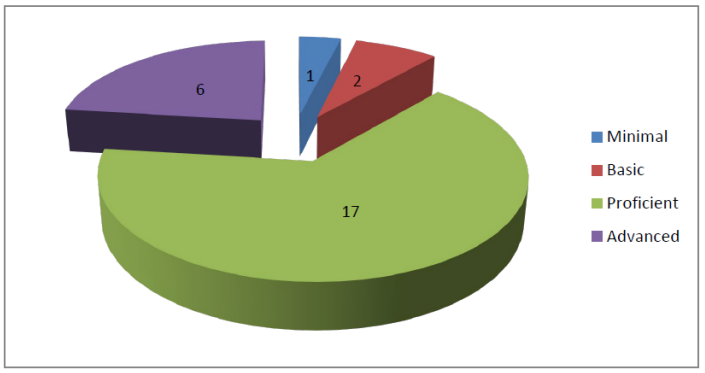


Analysis: Rubric to Assess Student Learning Outcome (3)
Course: ECGP-556-04 - Spring 2017 - Assignment 4 - CNTFET Analysis using Hspice
Intended Outcome: An ability to use the techniques, skills and modern engineering tools necessary
Mininal (10), Basic (15), Proficient (20), Advanced (25)

	(4) Justification of Anaysis	*Result with*
Student 1		20
Student 2		20
Student 3		20
Student 4		25
Student 5		20
Student 6		15
Student 7		25
Student 8		20
Student 9		20
Student 10		20
Student 11		20
Student 12		25
Student 13		25
Student 14		20
Student 15		25
Student 16		20
Student 17		10
Student 18		20
Student 19		20
Student 20		20
Student 21		15
Student 22		20
Student 23		20
Student 24		20
Student 25		25
Student 26		20

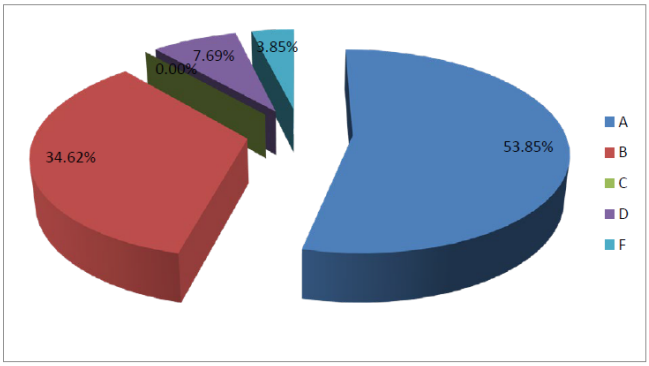
Rubric Scale	*Count*
Minimal	1
Basic	2
Proficient	17
Advanced	6



Analysis: Rubric to Assess Student Learning Outcome (3)
Course: ECGP-556-04 - Spring 2017 - Assignment 4 - CNTFET Analysis using Hspice
Intended Outcome: An ability to use the techniques, skills and modern engineering
Mininal (10), Basic (15), Proficient (20), Advanced (25)

	Total score	*Letter Grade*
Student 1	90	A
Student 2	90	A
Student 3	80	B
Student 4	100	A
Student 5	90	A
Student 6	60	D
Student 7	100	A
Student 8	80	B
Student 9	90	A
Student 10	90	A
Student 11	80	B
Student 12	100	A
Student 13	100	A
Student 14	80	B
Student 15	100	A
Student 16	80	B
Student 17	40	F
Student 18	80	B
Student 19	80	B
Student 20	80	B
Student 21	60	D
Student 22	95	A
Student 23	95	A
Student 24	80	B
Student 25	100	A
Student 26	95	A

Count	*Grade*	Percentage
14	A	53.85%
9	B	34.62%
0	C	0.00%
2	D	7.69%
1	F	3.85%



C. Quality indicator as evidence of effectiveness/success other than SLO

Another indicator other than the SLOs as evidence of effectiveness or success would be the comprehensive exam. In each semester, a comprehensive exam is given to graduate students who are in their last semester on three different graduate courses. Faculty members who taught the corresponding course in the previous semesters come up with a set of questions. If more than one faculty members taught the same course, all of them produce their own set of questions and students can answer their own instructor's question set. Students must obtain at least 60% in overall and in each course to pass the exam. If one fails the exam, one more attempt is given.

Students who choose to conduct research with one of the faculty members do not have to take the comprehensive exam. However, they must pass the oral presentation on their thesis or project.

In sum, all of these would serve as evidence of effectiveness or success of the program.

D. Computer Engineering Program does not offer courses and programs via technology (on-line) or at off campus sites and in compressed schedules.

IV. ***Faculty***

A. Full Time Equivalent Faculty (FTEF) allocation to the program; tenure density

The Computer Engineering Program currently has 8 full-time tenured and tenure-track faculty members. Among them, 3 are tenured and 5 are tenure-track. Among the three tenured members, one is full professor and the other two are associate professor. In this 2018-2019 academic year, the program has conducted another faculty recruitment and successfully hired 1 new member who will be joining the program in the following 2019-2020 academic year. The current FTEF is fine to cover all the graduate courses with approximately 20-30 students in each class. However, if the enrollment grows, additional faculty members will be necessary in the future. The current faculty members are very well qualified to cover a whole range of computer engineering disciplines/fields, including nanoelectronics, computer architecture/organization, mixed-signal processing, hardware security, audio/image processing, internet of things, VLSI testing, and design for testability.

B. Role of full-time or part-time faculty and student assistants in the program's curriculum and academic offerings

Every faculty member can give ideas to improving their course to meet the needs of recent technology developments. However, the continuous improvement committee typically makes curricular decisions after receiving ideas and suggestions from the faculty. Usually, every graduate course is offered and taught by full-time faculty member; however, if it is necessary to open multiple sections of the same course, part-time faculty members can offer one of the sections. Student assistants, if any, support faculty members with grading. In some graduate courses that require hands-on experiments, student assistants can help with lab sessions.

C. Computer Engineering Program does not have Special Sessions self-support programs.

V. ***Student Support and Advising***

A. Graduate student advisement

The program has a graduate program advisor who continuously takes the time to meet with students and provide advice until they successfully graduate.

Main features of the graduate advisement are as follows:

- Reviewing graduate transcripts and identifying deficiency/prerequisite courses
- Giving information to students regarding various graduate resources available on campus
- Recommending selected students for tuition and fee waiver after reviewing their records
- Coordination with the Office of Graduate Studies and the CpE Program Coordinator
- Meeting with graduate students to discuss progress and putting in place remedial measures, if needed (such as reinstatement after disqualification)
- Development and approval of Student Study Plans
- Graduation checks (before graduation to verify which of the graduation requirements have been met)
- Completion memos for certifying completion of exit options

B. Opportunities for students with research and internships

In each academic year, graduate students participate in a career fair event, specifically tailored to students of College of Engineering and Computer Science (ECS). This is where many students obtain internships. Each career

fair is represented by over 30 local industries in Orange County and southern California, including Boeing, Raytheon and Western Digital. In addition, research or project is done primarily with the full-time faculty. Faculty members of the computer engineering program have been very actively involved in conducting research and securing internal/external grants. These scholarly activities and accomplishments are indicated in faculty CV in the Appendix of this Self Study Report.

VI. ***Resources and Facilities***

A. Facilities/equipment used by the program such as laboratories, computers, large classrooms, or performance spaces

The Program of Computer Engineering provides a strong theoretical and practical understanding in both the hardware and software aspects of computer-based systems. The computing facilities at CPE program provide dedicated resources for instructional and research activities. Below are the labs and equipment which are available to the faculty and students. Currently, one more computer lab/classroom is being prepared for the computer engineering program. This additional lab/classroom will be used in conjunction with CS-301 for a large class in which more computer stations are needed for lab activities.

- **FPGA and Digital Electronics Lab (CS-301)**
  The facility in this laboratory supports undergraduate and graduate computer engineering courses. This room has desks with retractable stands for computer monitors and the latest in digital technologies, such as interactive educational software, classroom management software, document camera, and USB tablets.
  - Hardware
    - Dell Precision Workstations with Intel i7 processors
    - Digilent Nexys 4 FPGA boards
    - Dragon 12 development kits
    - Printers and projector
    - Texas Instruments (TI) MSP432 LaunchPad development kits
    - Texas Instruments (TI) C6713 DSP starter kits (DSKs)
    - Wacom pen tablets
  - Software
    - Cadence products for analog, digital and mixed-signal IC design
    - Code Compressor Studio (CCS) IDE for programming TI micro-controllers and DSPs
    - HSpice for simulation of analog and digital circuits
    - MATLAB for various simulations

        - MicroWind for chip layouts
        - ModelSim for ASIC and FPGA simulation
        - MultiSim for mixed mode simulation of analog and digital circuits
        - Xilinx ISE and Vivado for design, simulation and implementation of digital designs on FPGA

- **VLSI Lab (CS-404)**
  The lab has been recently upgraded with state-of-the-art workstations and commercial EDA tools. The facility in this lab not only supports undergraduate and graduate VLSI courses, but is also a training and research facility in advanced VLSI design. Using this facility, microchips can be potentially designed with submicron feature size and clocks in the Gigahertz frequency range.
  - Hardware
    - The lab is equipped with twenty workstations (Sun Ultra 40 M2)
      - Two dual-core AMD Opteron processors
      - Supports 32-bit and 64-bit applications
      - 4 GB DDR2
      - 15,000 rpm SAS HDD
      - 24.1-inch LCD monitors with wide viewing angle
  - Software
    - Cadence analog, mixed-signal and RF tools
    - Cadence ASIC tools
    - Mentor Graphics Custom Design & Simulation tools

- **Microcontroller Lab (CS-406)**
  The facility in this lab supports undergraduate and graduate courses in use of advanced microcontrollers targeted for embedded applications.
  - Hardware
    - The lab is equipped with 20 stations with Pentium 4/Pentium D processors, 1 projector, 2 printers, 25 68HC12 microcontroller development boards, 8 HP and Tektronix logic analyzers and digital logic test boxes.
  - Software
    - MultiSim
    - ModelSim
    - Xilinx ISE and Vivado
    - Freescale CodeWarrior
    - LabView
    - MATLAB
    - PSpice
    - Synopsis Tools

- **Computer Engineering Design Project Lab (E-323)**
  The facility in this lab supports undergraduate and graduate courses in use of advanced microcontrollers and FPGAs. The lab is equipped with 20 stations with Pentium 4/Pentium D processors.

B. Current library resources for the program and needs in the future

Designed to facilitate the delivery of recorded knowledge and information in support of instruction and faculty research, the Library serves as the hub of the University's information and instruction network. The Library also participates in the University's instruction programs and shares its commitment to lifelong learning of students. The University Library's website (http://www.library.fullerton.edu) serves as a gateway to information about library resources and services and is a vital component of the Library's extensive instruction program.

Equipment and Technology

Pollak Library holds just over 1,350,000 volumes and provides access to a wide variety of electronic content, including over 200 databases and nearly 200,000 eBooks. Databases of interest to Computer Engineering include:

- ACM Digital Library
- Engineering Village
- IEEE Xplore
- Web of Science
- ScienceDirect
- SpringerLink Journals
- OmniFile full Text Mega
- Academic Search Premier
- Access Science
- Compendex
- Wiley Online Library

The Library also utilizes the Summon discovery service which can be accessed through our Basic Search. Summon provides users with access to thousands of journals including many in the fields of Computer Engineering.

Library Facilities

The Pollak Library has over 500 computers available located throughout the North and South buildings. The library is also home to the Information & Learning Commons (ILC), a main hub for research activities. A service desk staffed by the Reference Team (librarians and library staff) and Information Technology staff is located on the first floor to assist users with research needs and to provide technical support. Wireless access and docking stations

are available throughout Library North and Library South. Electronic resources for the visually disabled are also available.

VII. ***Long-term Plans***

A. Summary of the program's long-term plan

As a long-term plan, the program would like to: 1) recruit more highly-qualified diverse faculty; 2) find more space and/or reallocate the current research space to support faculty research; 3) provide graduate students with more financial support in the form of funding or teaching opportunities within the program; 4) diversify the program's teaching and research areas to help graduate students become an engineer who fits in the field; 5) improve the learning assessment strategies to improve the overall quality of the program's curriculum; 6) become a department to obtain more support from the state and eventually establish the program as one of the top choices for master's program in computer engineering in Orange County and southern California.

B. How long-term plan implements the University's mission, goals and strategies

The long-term plan of the program listed above is directly aligned with the University's and the Computer Engineering Program's mission and goals. The first long-term plan directly aligns with University's Goals and Strategies I: Ensuring the preeminence of learning through recruit and retain a highly-qualified and diverse staff and faculty. The second long-term plan aligns closely with University's Goals and Strategies III: Enhancing scholarly and creative activity by supporting faculty research and grant activity that leads to the generation, integration and dissemination of knowledge. The third long-term plan follows the University's Goals and Strategies V: Creating an environment where all students have the opportunity to succeed by providing efficient and effective financial aid system. The fourth and fifth long-term plan match well with University Goals and Strategies I: Ensuring the preeminence of learning through recruit and retain a highly-qualified and diverse staff and faculty. The sixth long-term plan aligns well with University Goals and Strategies II: Providing high quality programs that meet the evolving needs of our students, community and region.

C. Evidence used to measure the program's results in pursuit of its goals

The evidence of faculty productivity through teaching performance, scholarly activities, external funding, increased financial support for students, and increased enrollment number will be used to measure the Computer Engineering Program's progress. All the data will be continuously collected and regularly evaluated to assess the status of the program in pursuit of its goals.