ABET
Self-Study Report

for the

Electrical Engineering program

at

University of California

Riverside

July 1, 2012

CONFIDENTIAL

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BACKGROUND INFORMATION

BG.1 Contact Information

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BG.2 Program History

The Electrical Engineering undergraduate program was established in 1989. The first EE undergraduate degrees were awarded in 1993. The EE Program officially became the EE Department in 97/98. A graduate program with MS and PhD degrees was added in Fall 1997. The first PhD student completed his degree in Spring 2001.

The EE program was first ABET accredited in 1994 and has been accredited continuously thereafter. The last ABET review was held in 2006-2007. See Section BG.15 below for a discussion of those results.

BG.3 Enrollment and Degree Conferral

The recent history of Electrical Engineering enrollment and degrees conferred is shown in Figure BG-1 below. Undergraduate enrollment represents the total number of EE students. Graduate enrollment represents the total of M.S. and Ph.D. students. Both the enrollment and the conferred degrees show long-term growth modulated by short-term fluctuations. In 2010, the number of B.S. degrees conferred hit a minimum corresponding to the low enrollment approximately four years earlier. The last three years have seen strong increases in enrollment and the acceptances for Fall 2012 are expected to be above 90 (see Fig. BG-1).

As of Summer 2011 the EE program had 814 alumni (558 BS, 154 MS, 102 PhD). Of these, the Bourns College of Engineering (BCOE) has either first or current places of employment for 365 alumni. Table BG-1 is a selected list of companies that have hired EE alumni. Total number of hires of these 365 alumni by all companies in the table is 106. The companies printed in boldface are represented on the EE Board of Advisors (BoA). The underlined companies are the most frequent employers of our alumni. The current Board of Advisors plans for its future are discussed in below under Board of Advisors.

BG.4 Quality of the Incoming Class

Figure BG-2 shows the history of grade point average (green) and Scholastic Aptitude Test (red) scores for admitted (square markers) and enrolled (triangle markers) freshmen in the EE program. The overall trends are positive, subject to short-term fluctuations. Criterion 1A discusses the admissions process and methods to improve the quality of the incoming cohort. The quality and process of transfer student admission is discussed in Criterion 1C.

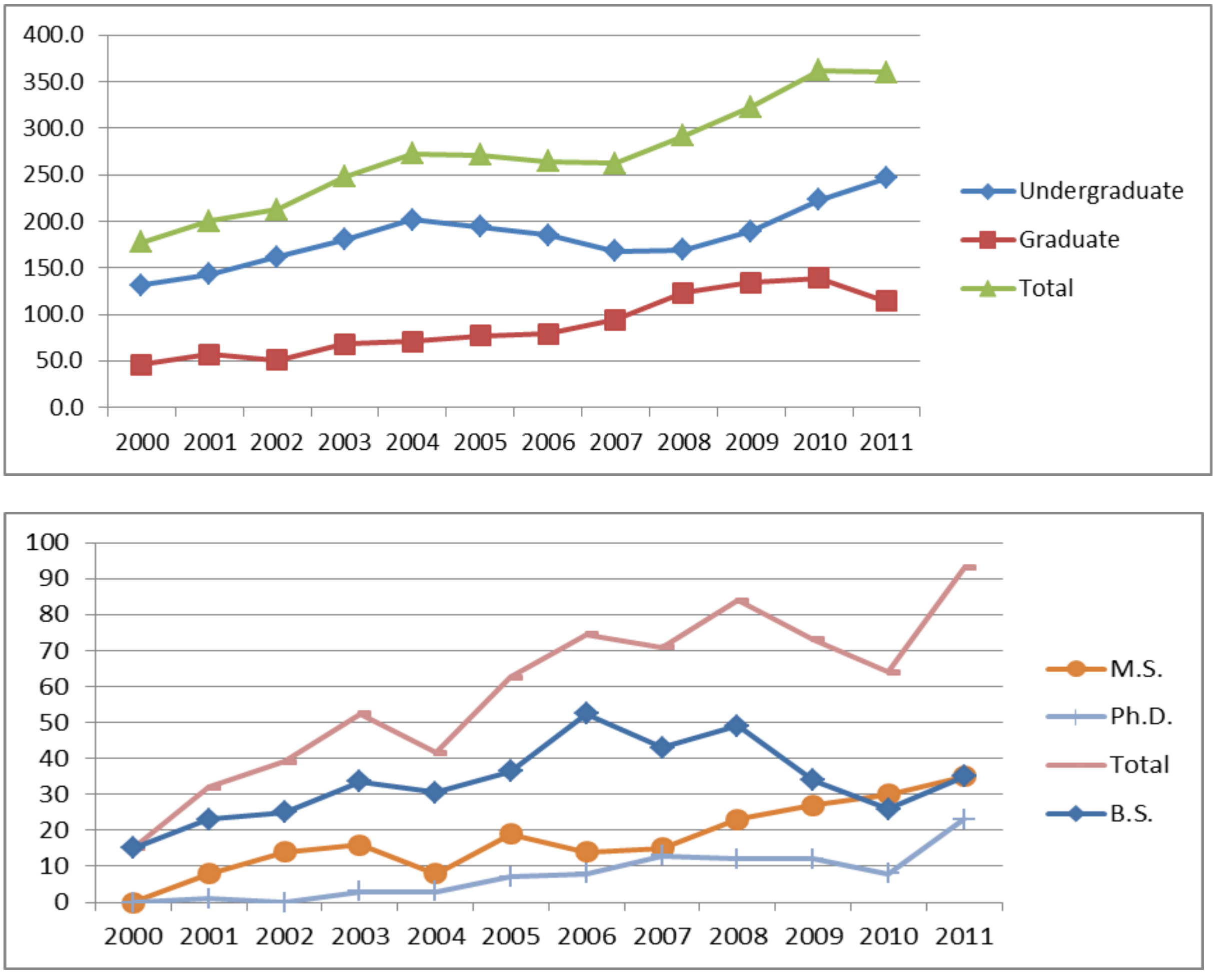


Figure BG-1. Enrollment and graduation trends for Electrical Engineering.

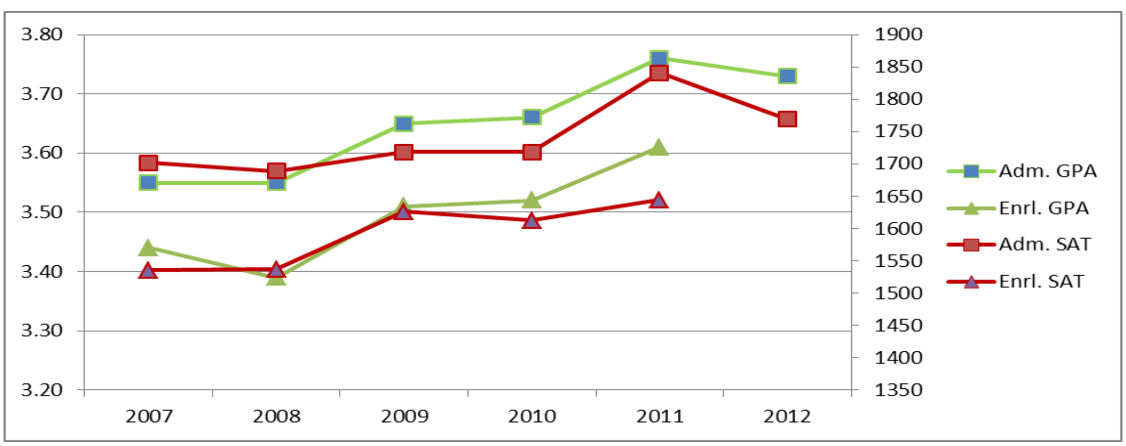


Figure BG-2. Quality of incoming class as indicated by grade-point average (GPA) and Scholastic Aptitude Test (SAT) scores.

BG.5 Quality of EE Graduates

The graduates of the EE Program have been employed by top companies like Qualcomm, Southern California Edison, and Northrop Grumman, the government sector like US Navy and California Air Resources Board, and top-tier graduate programs like Carnegie Mellon, Northwestern University, Harvard, UC San Diego, and Yale, to name just a few. See Table BG-1 for more details.

Table BG-1. Current employers of EE undergraduates. The companies in bold are represented on the Board of Advisors.

Abbott Vascular	Apple	Boeing
Broadcom	Cadence	Calif. Air Res. Board
Conexant	ESRI	General Atomics
Google	Honeywell	**IBM**
Intel	International Rectifier	KLA-Tencor
Lockheed Martin	Motorola	**NAVSEA Corona**
Northrop Grumman	NVIDIA	Qualcomm
Raytheon	SCE	Synopsis
TI	TRW	Verizon
Western Digital		

BG.6 History of Departmental and Program Leadership

The EE program is administered by the EE department. The departmental and its programs have a history of stable leadership as shown in the following Table BG-2. The title of the leader of the EE faculty has changed from Program Leader ('91-'96), to Program Chair ('96-'97), to Department Chair over the years with the growth of the program and faculty.

Table BG-2. History of program leadership.

Year	Chair/Leader	EE UG Advisor	EE ABET Coordinator	EE Graduate Advisor
91/92	Bir Bhanu	Bir Bhanu	Bir Bhanu	
92/93	Bir Bhanu	Bir Bhanu	Bir Bhanu	
93/94	Bir Bhanu	Bir Bhanu	Bir Bhanu	
94/95	Bir Bhanu	Bir Bhanu	Bir Bhanu	
95/96	Ping Liang	Ping Liang	Ping Liang	
96/97	Ping Liang	Ping Liang	Ping Liang	
97/98	Gerardo Beni	Gerardo Beni	Gerardo Beni	Jay Farrell
98/99	Jay Farrell	Jay Farrell	Jay Farrell	Ilya Dumer
99/00	Jay Farrell	Jay Farrell	Jay Farrell	Ilya Dumer
00/01	Jay Farrell	Jay Farrell	Jay Farrell	Ilya Dumer
01/02	Jie Chen	Jay Farrell	Jie Chen	Roger Lake
02/03	Jie Chen	Jay Farrell	Alex Balandin	Roger Lake
03/04	Jie Chen	Alex Balandin	Alex Balandin	Roger Lake
04/05	Jie Chen	Alex Balandin	Alex Balandin	Roger Lake
05/06	Jie Chen	Alex Balandin	Hua/Lyubomirsky	Roger Lake
06/07	Roger Lake	Jay Farrell	Ilya Lyubomirsky	Alex Balandin
07/08	Roger Lake	Ping Liang	Amit Roy-Chowdhury	Alex Balandin
08/09	Roger Lake	Ping Liang	Amit Roy-Chowdhury	Ertem Tuncel
09/10	Roger Lake	Ping Liang	Amit Roy-Chowdhury	Ertem Tuncel
10/11	Roger Lake	Ping Liang	Amit Roy-Chowdhury	Albert Wang[1]
11/12	Jay Farrell	Ping Liang	Amit Roy-Chowdhury	Ertem Tuncel

BG.7 Physical Housing of the EE Program

Since it was founded, the department and its faculty have been housed in three distinct locations. Originally, the EE department and the entire College of Engineering were housed in University Office Building, which was a generic space temporarily assigned while the first engineering building was planned and constructed. As that building neared completion in 1994, the Marlan and Rosemary Bourns family contributed a $6M gift, which resulted in the first engineering building being named Bourns Hall. The EE faculty offices, teaching labs, and research labs (along with all of the Bourns College of Engineering (BCOE)) moved to Bourns Hall when it opened in 1995. The Bourns Hall research labs were all equipped as wet lab space; therefore, as the college grew a second engineering building was planned that included dry lab space. The EE faculty, departmental staff, and dry teaching and research labs moved to this new building in 2005. In the 11/12 academic year, Winston Chung donated in excess of $10M to BCOE and this second building was named Winston Chung Hall (WCH).

[1] Replacement for Ertem Tuncel who was on sabbatical.

Each of the EE department's two moves has resulted in increasingly appropriate accommodations of the department's expanding number of students and faculty, with associated needs for teaching and research space.

BG.8 Rankings

The EE program was first ranked by US News & World Report in the 09/10 academic year with a rank of 57. Subsequent ranks are 75 in 10/11, and 62 in 11/12. The more rigorous but less frequent National Research Council (NRC) S-Rankings from 2010 placed the EE program in the top quarter of the nation (Figure BG-3) and shows that the UCR EE department compared favorably with our more well-established UC sister programs.

BG.9 Faculty

During the 11/12 academic year the EE department had 19 FTE tenure or tenure track faculty. Over the last five years, the department has hired five faculty and expects to hire at least one more to start in Fall 2012:

- Albert Wang (Ph.D. 1996, State University of New York at Buffalo) was hired as a Full Professor in 2007. He has expertise in RF/analog/mixed-signal integrated circuits; on-chip electrostatic discharge; system-on-a-ship; IC CAD and modeling; nano and emerging devices and circuits.
- Elaine Haberer (Ph.D. 2005, University of California, Santa Barbara) was hired as an Assistant Professor in 2008. Her expertise is in bio-templated materials for electronic, optoelectronic, and energy applications; nano-structured hybrid materials; novel top-down and bottom-up assembly techniques.
- Anastasios Mourikis (Ph.D. 2008, University of Minnesota) was hired as an Assistant Professor in 2008. His expertise is in autonomous vehicle localization; multi-robot systems; estimation in mobile sensor networks; vision-aided inertial navigation; simultaneous localization and mapping.
- Wei Ren (Ph.D. 2004, Brigham Young University) was hired as an Associate Professor in 2011. His expertise is in in distributed control of multi-agent systems; networked control systems; autonomous control of unmanned vehicles.
- Qi Zhu (Ph.D. 2008) was hired as an Assistant Professor in 2011. His expertise is in design methodologies and tools for distributed embedded systems, cyber-physical systems, computer-aided design for circuits.
- Hamed Mohseian-Rad (Ph.D. 2008) was hired as an Assistant Professor in Fall 2012. His expertise is in energy systems and optimization.

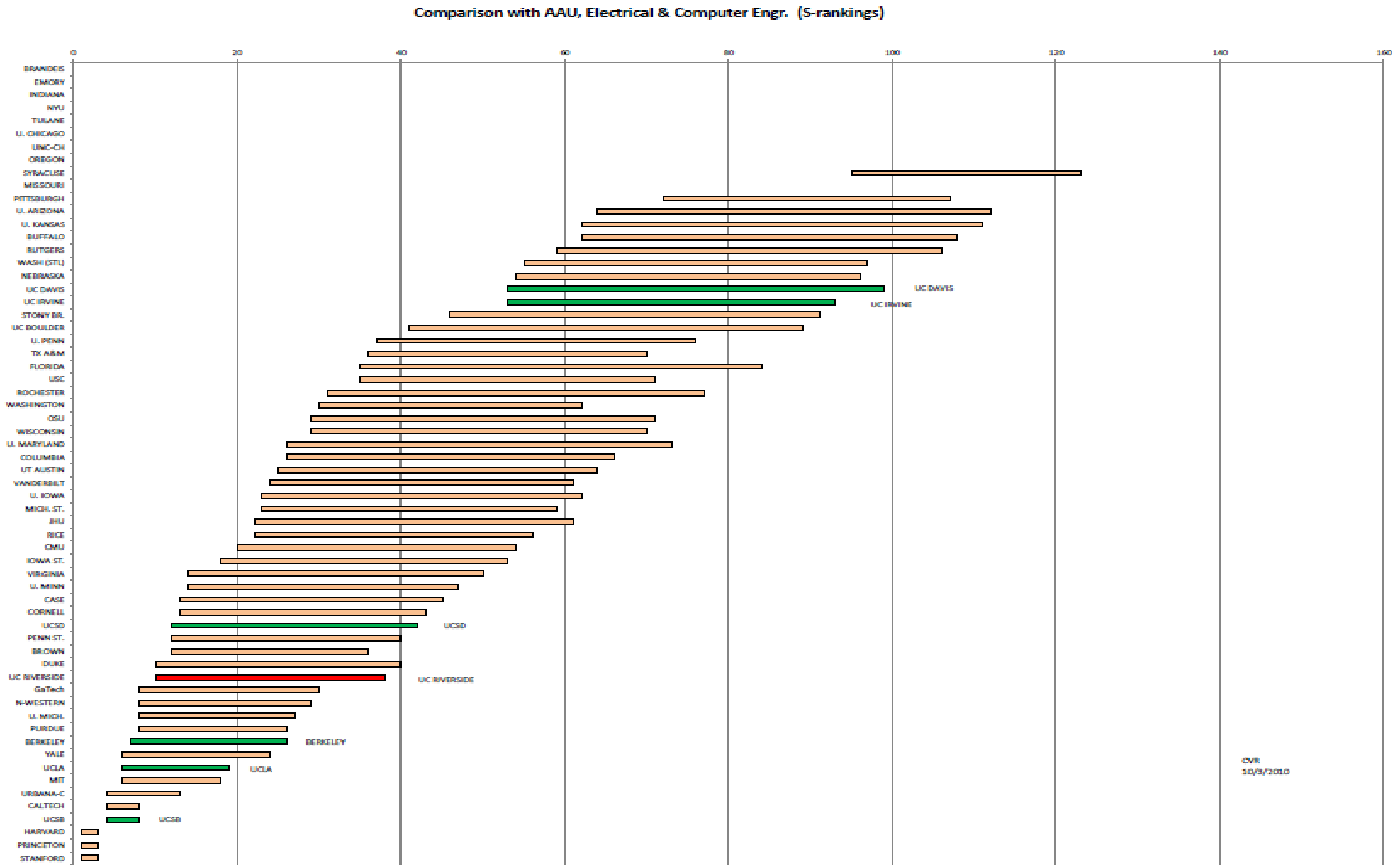


Fig. BG-3. 2010 National Research Council ranking of EE programs shows the UCR program (red line) in the top quarter of the nation. Other University of California electrical engineering programs are in green. The shorter the line and the farther to the left, the better the ranking.

Over the same time, two faculty have taken extended leaves of absence:

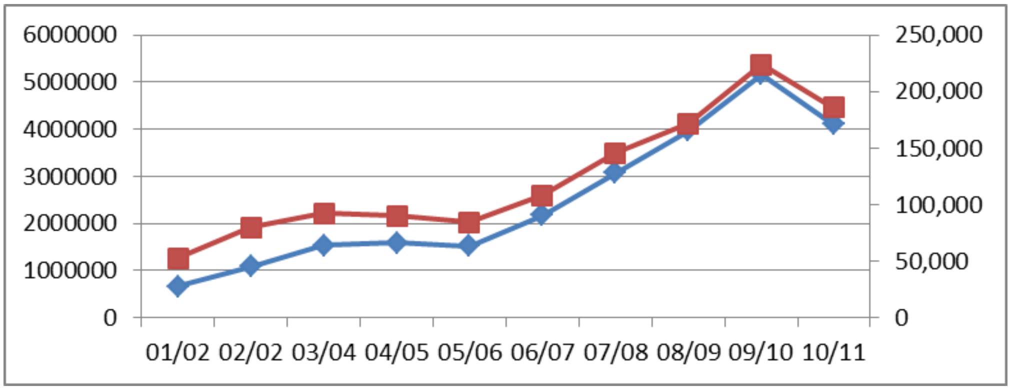
- Jie Chen (LOA: 10/11 – 12/13) is at City University of Hong Kong.
- Daniel Xu (LOA: 11/12 – 13/14) is at Tsinghua University.

and four faculty have left the department:

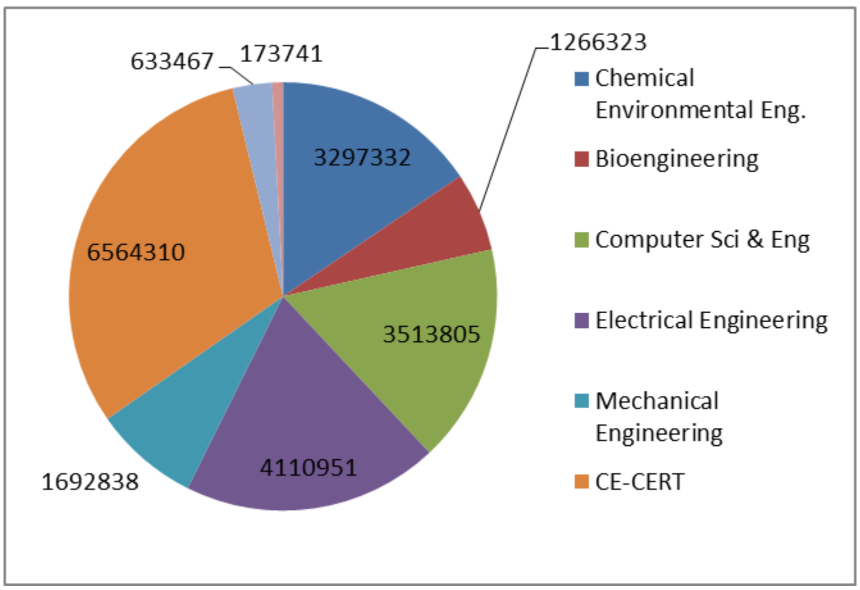
- Ilya Lyubomirsky left as of the end of 10/11
- Afshin Abdollahi left as of the end of 10/11.
- Gerardo Beni retired as of the end of 10/11.
- Sakhrat Khizroev left as of the end of 10/11.

All EE faculty are research active. The top graph in Fig. BG-4 shows the history of total and per faculty research expenditures for research projects managed through the EE department. The dollar amount of expenditures is growing strongly. In addition, this graph understates the total research funding of the EE faculty, as various EE faculty also submit grants through Centers associate with BCOE: CRIS, CE-CERT, UC-LIGHT and CNSE. The bottom graph in Figure BG4 shows the breakdown of research expenditures by unit within the BOCE. The EE department has the largest research expenditures among the departments of BCOE. An active research faculty benefits the EE UG program in various ways. The faculty are up to date on the latest trends in EE, can present the curriculum in innovative ways, have contacts in industry and at other universities to assist graduating students with placement, the research attracts high quality graduate students who are then available as TA's and mentors on undergraduate projects. In the present year, 27 UG students are participating in UG research projects (4 sophomores, 8 juniors, and 19 seniors).

The department has seven (7) IEEE Fellows, seven (7) AAAS Fellows, two (2) APS Fellows, two (2) SPIE Fellows, and one Fellow each of IAPR, IFAC, IOP, and OSA. Six (6) faculty have received NSF Career awards. Two (2) faculty have received ARO Young Investigator awards. One faculty has received an ONR YIP award. One faculty has received an NSF BRIGE award.



EE Research Expenditures. The left scale is total EE department expenditures (blue curve). The right scale is the per faculty EE expenditures.



BCOE Research Expenditures per unit. EE has the largest departmental research expenditures among the BOCE departments.

Figure BG-4. EE faculty research productivity.

BG.10 Board of Advisors

The current BOA membership is shown in Table BG-3:

Table BG-3. Electrical Engineering Board of Advisors membership.

Anil Agarwal	Director of Engineering	Skyworks Solutions
Stephen Badgett	Deputy Director – Energy Delivery	Riverside Public Utilities
Howie Chu	President	ZyXel Communications
Jean Easum	Supervisory Scientist	**Naval Surface Warfare Center**
Hossny El-Sherief	Manager	**Northrop Grumman Corporation**
Kumaran Krishasamy	Principal Engineer	**Broadcom**
Bin Lu	Director	Seagate Media Research Center
William Luebke	Technical Director	**Naval Surface Warfare Center**
Meyya Meyyappan	Chief Scientist for Explor. Techn.	NASA Ames Research Center
Sani Nassif	Research Manager	**IBM** Austin Research Lab
Dennis Rice	Vice President (Retired)	**Northrop Grumman**
J. R. Richardson	Principal Systems Engineer	**Raytheon**
Patrick Sain	Principal Multi-Disciplined Eng.	**Raytheon**
Joel Schulman	Senior Scientist	The Aerospace Corporation
Allyson Yarbrough	Principal Director	The Aerospace Corporation
Ron Young	Engineer	GM ATV
Paul Yu	Associate VC for Research	UC San Diego
Bin Zhao	Director, S. CA Dev. Center	Fairchild Semiconductor

Kumaran Krishasamy is currently the only alumnus serving on the board. In the right column, the companies in boldface are known to have hired EE alumni. The BOA is active and supportive, reviewing and providing advice on the EE mission, vision, objectives, program, and curriculum.

At the time the BOA was established, the number of alumni was very limited. Therefore, the board was formed from representatives companies that we expected to hire UCR EE graduates. Moving forward as we add new BOA members, a few objectives will be:

- to increase the representation of alumni who have been working at least five years,
- to increase the representation of companies who have hired significant numbers of UCR EE graduates, and
- to balance the membership knowledgeable about the various focal areas of the EE department.

Alumni who interact with the department by offering lectures in EE010 (a freshman course geared to increase retention) will be likely candidates for future inclusion on the BOA (more details in Section 4.3).

At the May 10, 2012 meeting, a draft set of Bylaws and Procedures was circulated by the EE Chair with a request for comments and consideration. The Bylaws are intended to clearly state the BOA objective, primary functions, terms and responsibilities of membership, and meeting schedule. A revision of those Bylaws and Procedures will be considered at the next BOA meeting.

BG.11 Options

Undergraduates in the EE program have the option of choosing technical electives from five focus areas, namely Intelligent Systems (IS), Nanomaterials, Advanced Devices and Circuits (NMDC), Communications and Signal Processing (CSP), Controls and Robotics (CR) and VLSI. These are, however, not formally mentioned in the transcripts.

BG.12 Organizational Structure

The organizational structure is shown in Figure BG-5. Each program is lead by a program chair. For EE, the Program Chair and is also the EE Department Chair. The Department and Program Chairs report to the Dean, who reports to the EVC/P, who reports to the Chancellor.

Figure BG-6 shows the process by which course and program changes are approved. The desire or suggestion for a program, course or curriculum change may arise from any of the various feedback channels, but are ultimately referred to the faculty for implementation. The UG committee works with subsets of faculty to devise appropriate changes. The proposed changes are routed through the EE Faculty, the Bourns College of Engineering (BCOE) Executive Committee, and the Academic Senate Committee on Courses and the Academic Senate Committee on Educational Policy. Discussions may occur and revisions may be suggested throughout the process.

BG.13 Program Delivery Modes

All courses for the bachelor's degree are delivered in campus classrooms and laboratories on weekdays and weeknights. The curriculum includes no cooperative education, distance education, or web-based instruction. The EE program is offered through traditional lectures and laboratory sessions associated with the lectures. Students have the option to work as undergraduate researchers in various labs, working alongside graduate students and faculty. A senior design project is necessary for all undergraduate students.

BG.14 Program Locations

The program is offered at the campus of the University of California, Riverside.

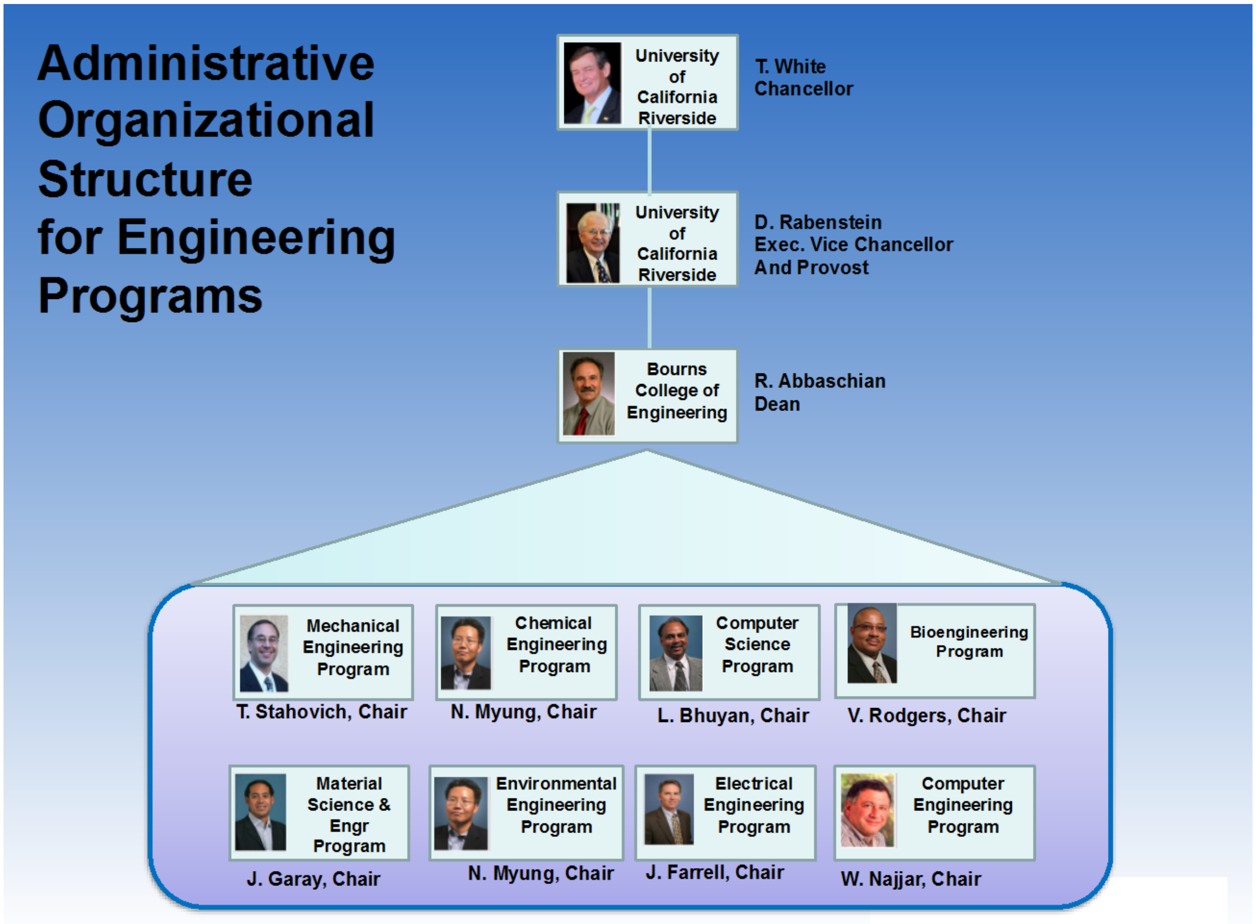


Figure BG-5. Organizational structure of the Electrical Engineering degree program within the context of the University of California, Riverside.

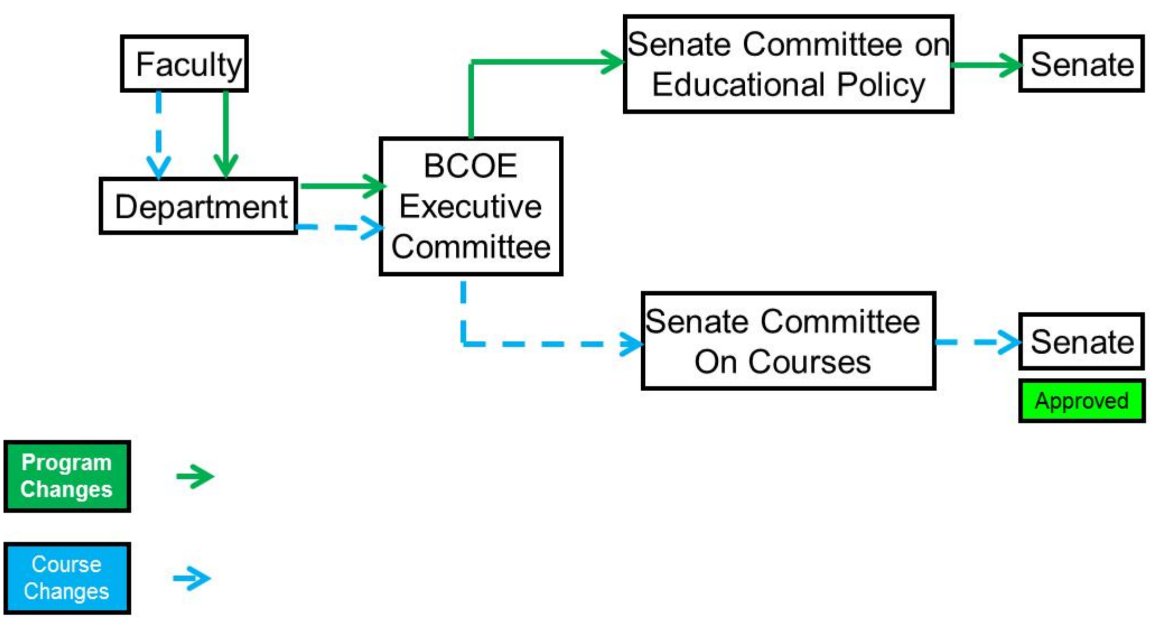


Figure BG-6. Approval process for changes to courses, curriculum and programs.

BG.15 Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them

The following is a timeline of the last EE ABET review.

October 8-9-10, 2006: On-site ABET review.

January 12, 2007: The EAC Draft Final Statement identified four weaknesses for EE, in criteria 2, 3, 4, and 8.

February 13, 2007: EE submitted a response to the draft findings.

August 13, 2007: Final Statement from ABET said that the weaknesses on criteria 4 and 8 are resolved; the weaknesses on criteria 2 and 3 are unresolved and will require a follow-up report in 2008 (but no follow-up visit).

June 20, 2008: EE submitted a response to the remaining weaknesses.

January 6, 2009: All remaining weaknesses were resolved.

July 1, 2009: Effective date of final EAC approval.

A summary of the weaknesses cited in the review and the due process response are summarized below.

Criterion 2. Program Educational Objectives

Draft Final Statement: Criterion 2 states that the program must have "a process based on the needs of the program's various constituencies in which the objectives are determined and periodically evaluated." While a process exists, it is not clear that this process is clearly tied to feedback from the program's defined constituencies or what the time period is for re-evaluations of these objectives. Some objectives appear difficult to measure and some are similar to outcomes. Criterion 2 states that the program must have "a process of ongoing evaluation of the extent to which these objectives are attained, the result of which shall be used to develop and improve the program outcomes so that graduates are better prepared to attain these objectives." (While evaluation has been done, it is not yet clear that this is an ongoing process and that the loop is being closed to use in the evaluation results in program improvement.)

EE response: "This Draft Finding for Criterion 2 identifies four areas where further clarification is required: (a) the role of feedback from the program's constituencies; (b) the time period for re-evaluation of the objectives; (c) the measurability of objectives and the similarity of objectives to outcomes; and (d) evidence that evaluation is an ongoing process and that the loop is being closed. The following is a summary of the response."

For (a), the EE program mentioned that they can demonstrate evidence that feedback from our constituencies is being used to make changes in our Objectives and in Outcomes through the curriculum. For (b), the EE response outlined the timeline and process for obtaining feedback from faculty, alumni and industry/employers. For (c), a new set of PEOs were proposed after consultation with all constituents. These PEOs are the same as the ones in this review cycle, except for the part under "contributions to society". For (d), a number of examples of "closing the loop" were provided.

Final ABET statement: "The EAC acknowledges receipt of the documentation describing activity to define a new set of educational objectives that are focused on early career accomplishments and a description of a process for involving constituents in developing and reefing the objectives. The target date for approval of the new objectives and objective review/definition process was indicated to be May 2007. The weakness remains unresolved and will be the focus of the next review. In preparation for the review, the EAC anticipates evidence documenting the implementation of the new process."

EE response: EE responded with a new set of PEOs and a process for evaluating the PEOs. As part of this process, a survey was initiated, whose responses are summarized in Appendix F of this document. Examples of changes implemented as part of this process were provided in the response. One such change was the introduction of the programming course CS 13.

Final ABET response: This weakness is resolved.

Criterion 3. Program Outcomes and Assessment

Draft Final Statement: Criterion 3 requires "… an assessment process, with documented results, that demonstrates… program outcomes are being measured and indicates the degree to which the outcomes are achieved." While some assessment has been implemented, it does not appear that all outcomes are sufficiently measured and that achievement of all outcomes is being demonstrated. Sufficient evidence was not provided for the following outcomes: "b" and ability to design and conduct experiments, "d" an ability to function on multi-disciplinary teams, "f" an understanding of professional and ethical responsibility, "h" the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context, "j" a knowledge of contemporary issues."

EE response: "While items b, f, h, and j have been part of the material taught in the two quarter Senior Design project, EE175A/B, the demonstration of these outcomes was not well documented. The syllabus of EE175A/B has been rewritten so that these outcomes are explicitly included with corresponding assignments that will be documented and used to measure the students' performance in obtaining these outcomes."

"Starting in Winter and Spring of 2012, items b, f, h, and j will be documented for all EE students in either the EE175 final report, exam, or essay assignment. These instruments will be used to measure the program outcomes. Item d, an ability to function on multi-disciplinary teams, is being addressed in the two cross-listed courses EE/CSE 120A/B."

Details of the report will be provided to the ABET reviewer if needed.

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

EE response: (Although it was not necessary to respond to the concern, it was included in the EE response.) Evidence was provided that the changes in EE175 and EE120 were being implemented. Examples of modifications to the course structures were also provided.

Criterion 4. Professional Component

Draft Final Statement: Criterion 4 states, "Students must be prepared for engineering practice through the curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constrains." While the senior design projects in EE175 are of excellent quality, inspection of a sample of all reports and oral presentations did not provide sufficient evidence to demonstrate that all projects incorporate engineering standards and realistic constraints.

Criterion 4 also states, "The professional component must include… one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study." The program currently contains 66 quarter hours of electrical engineering topics, plus 20 hours of technical electives. Depending on how these electives are selected, it is possible for students to take 16 hours of computer science, which could lead to graduation without the 72 hours of electrical engineering topics required by this criterion.

EE Response: "While these were included, they were not adequately documented. To ensure proper documentation, the course syllabus for EE175A/B has been revised to include these items in the "Detailed Design Specification." Realistic constraints and industry standards are required sections."

"The description of the choice of EE electives in the UCR catalog has been modified to read: "The choice of technical electives must ensure that the upper division requirements include at least one coherent sequence of at least three (3) electrical engineering courses to ensure depth in one area of electrical engineering. Example course sequences are available through the Student Affairs Office in the College of Engineering or http://www.engr.ucr.edu /studentaffairs/." This ensures 78 quarter hours of electrical engineering topics."

Details of the report will be provided to the ABET reviewer if needed.

Final ABET Statement: "The EAC acknowledges the receipt of documentation that shows implementation of changes to the syllabus for EE175 A/B that will insure coverage of realistic constraints and standards and a change to the curriculum to insure adequate coverage of engineering topics by all students. The weakness has been resolved."

Criterion 8. Program criteria

Draft Final Statement: The electrical engineering program criteria state "The program must demonstrate that graduates have: knowledge of probability and statistics, including applications appropriate to the program name and objectives…" The program has a required course in probability and statistics taught by mathematics and statistics faculty, but does not demonstrate applications appropriate to electrical engineering theory and practice.

The criteria also state, "The structure of the curriculum must provide both breadth and depth across the range of engineering topics implied by the title program." While the curriculum insures that all students achieve adequate depth, the rules governing the selection of electives make it possible for a student to graduate by taking only an introductory course in multiple areas thus not achieving depth in any area.

EE response: The EE faculty decided that the best way to address this was to propose a new EE course, EE114 Probability, Random Variables, and Random Processes in Electrical Engineering, to replace the required course Stat 155. The new course includes applications specific to EE. The course will be in the 2007 – 2008 catalog and offered in the Spring of 2008.

The description of the choice of EE electives in the UCR catalog was modified to read, "The choice of technical electives must ensure that the upper division requirements include at least one coherent sequence of at least three (3) electrical engineering courses to ensure depth in one area of electrical engineering. Example course sequences are available through the Student Affairs Office in the College of Engineering or http://www.engr.ucr.edu /studentaffairs/."

Details of the report will be provided to the ABET reviewer if needed.

Final ABET Statement: The EAC acknowledges receipt of documentation that shows implementation of changes to the curriculum to insure adequate coverage of the application probability and statistics and that insure depth in at least one area of electrical engineering. The weakness has been resolved.

BG.16 Joint Accreditation
The Electrical Engineering program is being visited by EAC/ABET only.

GENERAL CRITERIA

CRITERION 1. STUDENTS

1.1 Student Admissions

The admissions processes for all engineering degree programs conform to the UCR Academic Senate's interpretation of the admission policies of the University of California, which, in turn, interpret the mandates of the California Master Plan for Higher Education. In broad terms, the Master Plan constrains the University of California to admitting only students ranking in the top 12.5% of the high school graduates in the State. Students in lower tiers are eligible for admission to campuses of the California State University system, or to community colleges. Placement in the top 12.5% of the graduating class is determined by the UC Eligibility Index, which is computed centrally by the UC Office of the President, based on criteria defined by the UC System-Wide Academic Senate.

Figure 1-1 summarizes the freshman admissions process to the Bourns College of Engineering. Prospective students submit their applications to the Office of Admissions for the University of California, which serves all ten campuses. Applicants may apply to multiple campuses, and to multiple programs at these campuses. They may also designate primary and alternate majors. The UC Office of Admissions determines whether each applicant meets the UC Eligibility criteria (Eligibility Criteria Link), which specify GPA and coursework requirements, and forwards each eligible application to the campuses to which admission is being sought. Ineligible applicants are rejected. If a student is UC-eligible, but is not selected for admission to the campus(es) that he or she applied to, admission to another UC campus is offered. It is notable that the Riverside campus switched from a referral campus to a selective campus within the past four years. That is, because of the increasing number and quality of students applying directly to UCR, we no longer offer admission to students who are UC-eligible but declined by their first-choice campuses. Nevertheless, we remain the most diverse campus of the UC system (in terms of overall numbers; on a percentage basis, UC Merced has greater diversity because of its very small student population). UCR has a substantial number of students who are the first in their families to attend college.

Within UCR, processing of the freshman applications begins through the Campus Office of Admissions, in accordance with guidelines defined by the Undergraduate Admissions Committee (UAC) of the UCR Academic Senate. An Enrollment Management Council (EMC) also exists at the campus level to make decisions annually on the enrollment targets at the campus and college levels. These decisions are informed by the strategic planning processes at the campus and college levels.

UCR follows a multi-tier admissions process. At the first tier, an Academic Index Score (AIS) is computed for each applicant, based primarily on academic parameters such as the grade-point average (GPA), the Scholastic Aptitude Test (SAT) score, and the number of completed Advanced Placement or International Baccalaureate courses. College-specific upper and lower AIS thresholds are determined in accordance with the planned enrollment targets. All applicants to a college whose AIS scores exceed the upper threshold are automatically admitted to their program of interest. All applicants with AIS scores below the lower threshold for each college are removed from that college's pool. The remaining applicants are forwarded to the respective colleges for further processing.

Once these forwarded applications arrive at BCOE, a BCOE-specific Index Score (BIS) is computed for each applicant. This BIS score is a function of the applicant's grades in mathematics and science, as well as the math part of the SAT Reasoning Test (the SAT Advanced test is not required by UC). The applicants to each program are ranked by BIS score, and applicants are admitted starting at the top of the list for each program until the program's enrollment target is met. Applicants may be placed on a wait list, to be admitted if the yield rate from the admitted pool is insufficient to satisfy program targets.

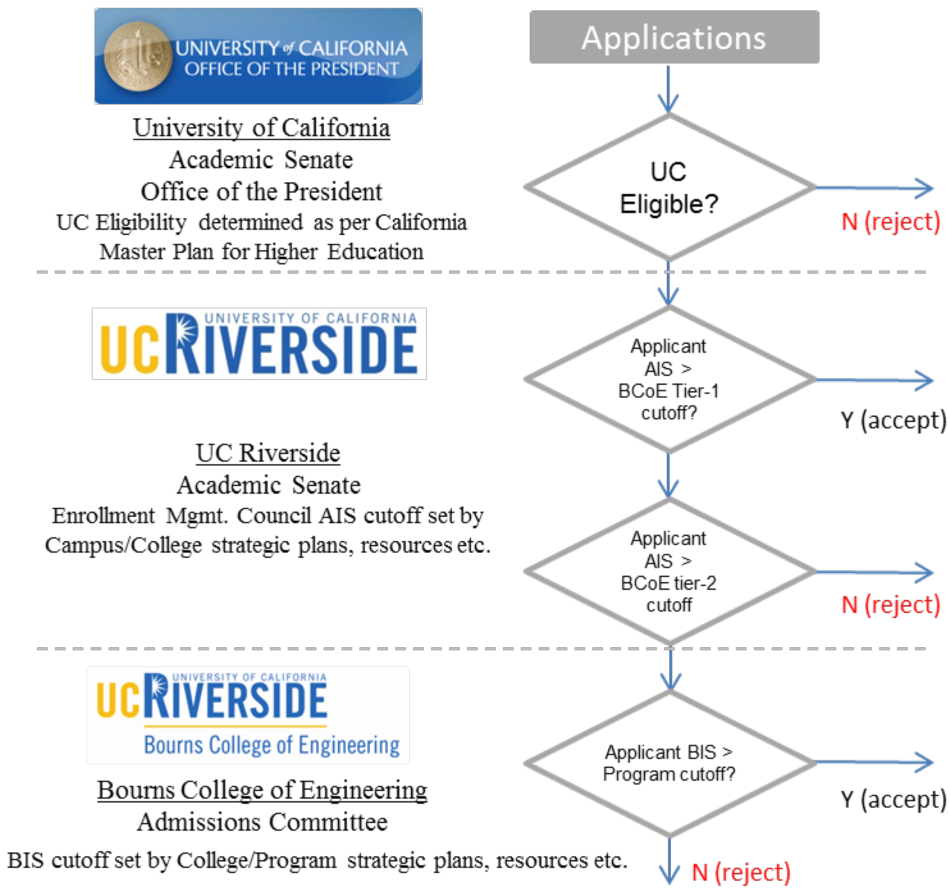


Figure 1-1. The UCR BCOE admissions process. The admissions process begins with an application to the UC system, which is forwarded to the campus and then to the college for consideration.

1.2 Evaluating Student Performance

Student performance monitoring is primarily the role of the Office of Student Affairs, under the supervision of the Associate Dean for Undergraduate Affairs, Professor C.V. Ravishankar. Each program also has a faculty member designated as the Program Faculty Adviser, who serves as the primary departmental contact for program-specific policy decisions. College-level policy is under the purview of the Associate Dean. The staff of Office of Student Affairs (OSA) supports the undergraduate programs. Section 1.4 provides details on the OSA.

Each student is assigned to a staff adviser in the OSA, and encouraged to meet with this adviser whenever the need arises, but at least once per quarter. In addition, attendance at a mandatory Annual Major Advising session is required of all undergraduates in the college. The Annual Major Advising session is conducted jointly by the OSA staff and the Program's Faculty Adviser, and provides information on a variety of topics to students, including program requirements as well as academic success strategies and professional development opportunities. Feedback on this advising process from the students is provided in Fig. 1.2 (a, c) below and shows that students are generally satisfied with the quality of advising.

In addition, students are advised by faculty also. The Undergraduate Advisor holds a Major Advising Meeting annually in the Fall quarter. The purpose of the meeting is to inform students of EE program changes, providing advice on selecting a technical focus area, preparing for senior design project, and career options after graduation. In the past, all EE majors are required to attend this meeting. In 2011/2012, it was changed to junior students only because they are at the point that can best benefit from such information. Starting in 2012, the Undergraduate Advisor also holds a Senior Design Project Informational Meeting annually in the spring quarter for junior students. The purpose of the meeting is to advise students on the structure of the senior design project course, provide them with topics for the design projects and introduce the instructors teaching the senior design course. The students are encouraged to meet with or contact the instructors and select a topic well in advance so that they can start preparing for the project over the summer before the start of the course in the fall quarter. Fig. 1.2 (b) shows satisfaction with faculty advising.

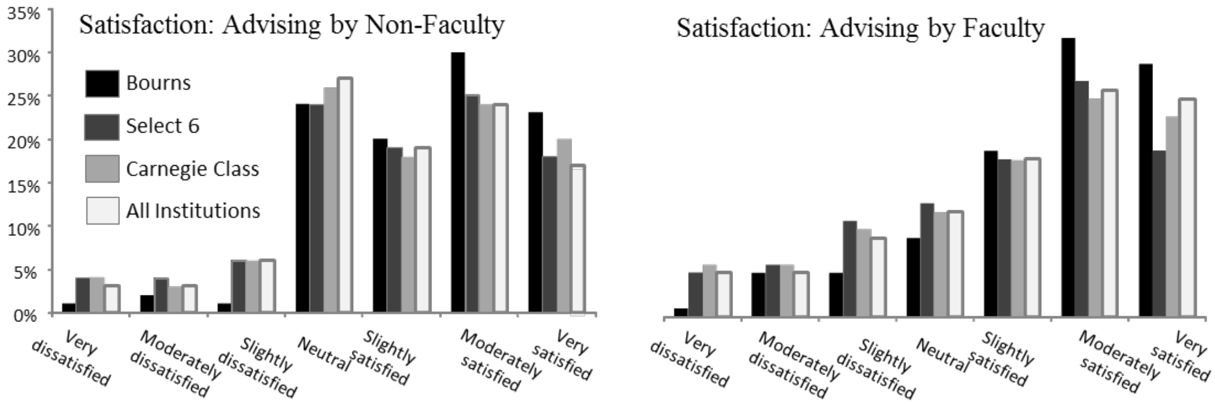
Many opportunities exist for undergraduate students in Electrical Engineering to become directly involved in ongoing research in faculty members' laboratories. Several EE faculty members are recipients of funding from programs such as the National Science Foundation's Research Experience for Undergraduates (NSF-REU) program and International Research Experiences for Students (IRES) program and US Department of Education's College Cost Reduction and Access Act (CCRAA), which afford undergraduate students the unique opportunity to work directly with faculty in research. For example, Professors Dumer, Tan, Balandin and Roy-Chowdhury are past or current recipients of the NSF-REU awards. Professors Tan and Wang are recipients of the NSF-IRES award. The students of Professors Barth, Liu, Lake, Farrell, Tan, Wang, Roy-Chowdhury are past or current receipts of CCRAA. EE Professors Tan and Ozkan actively participate as Faculty Mentors for the University of California Leadership Excellence through Advanced Degrees (UC-LEADS) program, a two-year program of scientific research and graduate school preparation for disadvantaged students. Faculty Mentors in this program assist the student in designing a plan of research and enrichment activities fitted to the academic goals of the Scholar, which includes academic year research experience, paid summer research experience, and attendance/involvement at professional meetings. EE faculty also advise two student groups on campus: Professor Dumer advises the Institute of Electrical & Electronic Engineers and Professor Ozkan advises the Society of Women Engineers. These groups involve students in the meetings and activities of these national societies while allowing them to connect and collaborate with fellow students at the local and regional levels. Moreover, the department routinely engages student clubs in campus wide outreach activities, such as Industry Day, Engineering Day, and Chancellor's Receptions. IEEE is one of the most active clubs at UCR. It is discussed further in Section 1.4.1.

Figure 1-3 depicts the process for monitoring student progress. Students are required to maintain a GPA of 2.0 each quarter, as well as cumulatively. Students are reminded of these requirements regularly, first during the registration process in their first quarter as freshmen, and again each year during Annual Major Advising. Grades are posted by instructors each quarter to the central Student Information System (SIS) database, which tracks student performance, and provides degree audits to check for completion of degree requirements. At the end of each quarter, staff advisers in the OSA review the academic records of BCOE students and identify all whose term and cumulative GPAs are below 2.0.

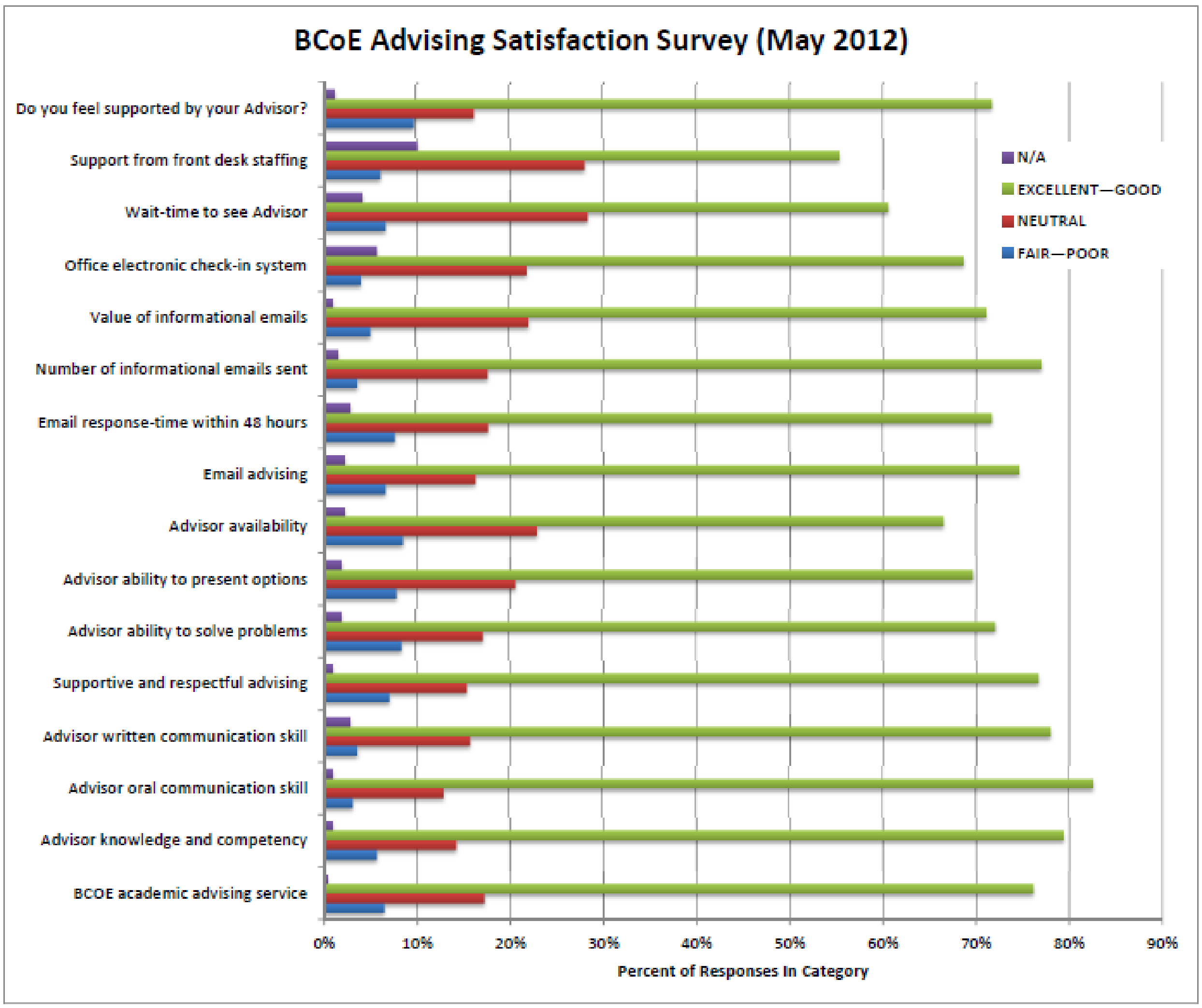
Failure to meet these GPA requirements results in a student being placed on probation. The student is notified of this probationary status, and advised that a failure to obtain at least a 2.0 GPA the following term will result in dismissal. A registration hold is placed on the student's record at that point, to be released only upon the completion of Academic Success Workshops and other advising and mentoring activities through the OSA. A student who receives a dismissal notice may appeal the dismissal to the Associate Dean, who may grant or reject the appeal based on extenuating circumstances.

The primary source of information regarding student performance is the campus-wide Student Information System (SIS). SIS, which is maintained by the campus Computing and Communications office, records all student registrations and grades. All staff and faculty advisers have access to this system, either directly, or through the Student Advising System (SAS) front-end that provides access to student transcripts and degree audits. The staff of the OSA uses this system regularly to monitor student progress.

Students who are about to graduate are required to complete a graduation application. At this point, the student's academic adviser in OSA performs a detailed manual check to ensure that all degree requirements have been met. If the requirements have been met, the Office of the Registrar is notified of degree completion, so the degree may be awarded.



(a) **(b)**



(c)

Figure 1-2. Student satisfaction with quality of advising.

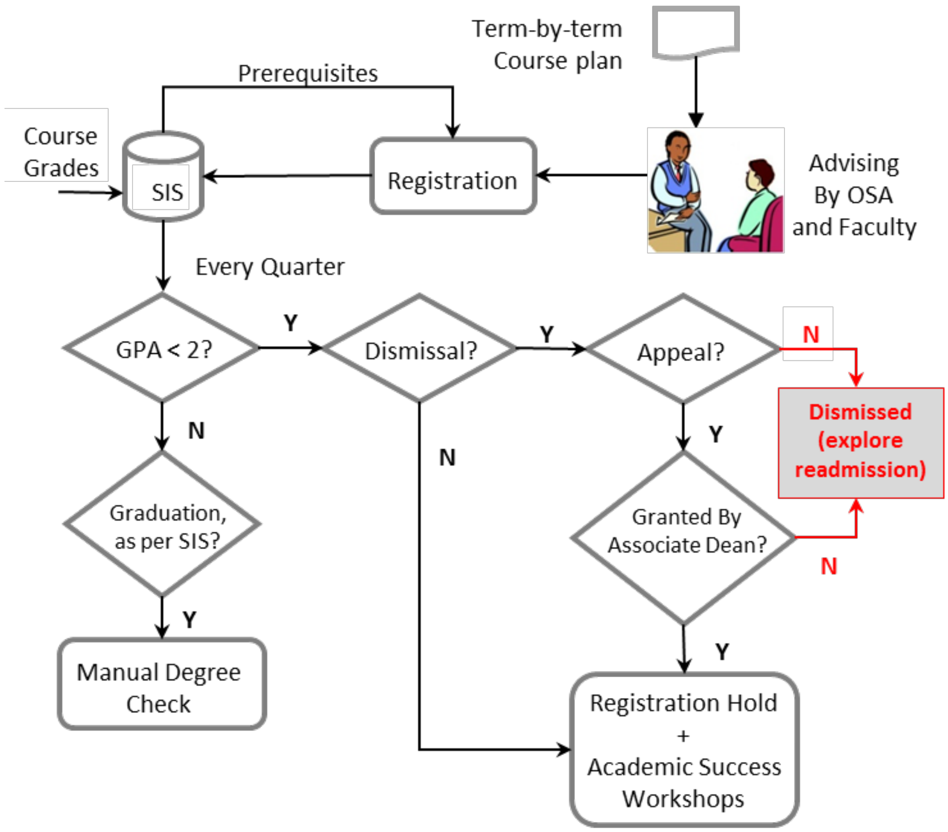


Figure 1-3. Academic advising and performance monitoring process.

1.2.1 Enforcing Prerequisites

All students are given a term-by-term course plan (see Criteria 5 Section A.1) that ensures timely graduation as long as courses are completed in a timely manner. This course plan incorporates prerequisites, so that students who follow the course plan automatically satisfy prerequisites. Table 5-1 under Curriculum shows the basic course plan for the Electrical Engineering program.

Whether or not students follow this course plan, prerequisites are enforced by the registration system. Students register for courses through the GROWL (GRades Online Web Link) system that interfaces with SIS, and is able to enforce prerequisites. A student prevented from taking a course due to lack of prerequisites can petition the faculty instructing the course and the undergraduate advisor. The undergraduate advisor has the authority to grant the student a prerequisite waiver. The student is not permitted to take the course without such a waiver. Such waivers are generally approved for outstanding students, transfer students and very special situations.

1.3 Transfer Students and Transfer Courses

Transfer students apply using the same application portal that freshmen use. This portal is maintained by the System-Wide Office of Admissions, which is located in Oakland, CA. This office collects applications and forwards them electronically to the UCR Office of Admissions.

In accordance with the California Master Plan for Higher Education, the University of California maintains extensive articulation agreements with community colleges in the state. Course articulations are reviewed and approved by the Undergraduate Advisor of each departments, and are tracked and maintained by the Campus Articulation Officer. All system-wide articulation agreements are available at the website http://www.assist.org, which is open access. The transfer route appears to be gaining popularity, especially given recent increases in tuition. When a transfer applicant (typically, from out of state) presents a transcript containing courses that have not already been articulated, the staff of the BCOE OSA collect the relevant course syllabi and work with the Undergraduate advisor of the cognizant departments at UCR to determine articulations.

All BCOE programs have published detailed requirements for transfer admission. Admission to our programs requires a minimum GPA and the completion of coursework specific to the desired major (see table below). Incoming transfer students may transfer up to 105 quarter units (70 semester units), with a minimum of 60 semester units (90 quarter units), toward their degrees from the University. To ease the burden of consulting http://www.assist.org for each major an applicant may be interested in, we have prepared brochures showing transfer requirements for each of our majors. We make these brochures available both in hardcopy, as well as on the Web. Some examples appear at http://www.engr.ucr.edu/undergrads/transferring/SpecialAgreements.html.

If the transfer applicant for a major meets all the requirements specified by that major, the UCR Office of Admissions admits that applicant. Applicants who satisfy most transfer requirements are forwarded to the College for additional review. The OSA staff reviews these applications, and in consultation with the departments and the Associate Dean, grants exceptions as warranted. Conditional admission is also sometimes granted, subject to the completion of some requirements that may not have been met at the time of application.

1.3.1 Transfer Admission Criteria:

UCR Transfer Admission Criteria:

- Complete 60 transferable units (90 quarter units) with a minimum GPA of 2.4 for California residents and 2.8 for nonresidents
- Complete (with a grade of C or better) the following course pattern:
    - Two transferable college courses (3 semester or 4-5 quarter units) in English composition
    - One transferable college course (3 semester or 4-5 quarter units) in mathematical concepts and quantitative reasoning
    - Four transferable college courses (3 semester or 4-5 quarter units) chosen from two of the following subject areas: arts & humanities; social & behavioral science; physical & biological sciences

General BCOE Transfer Admission Requirements:

- A cumulative GPA of at least 2.80.
- Completion of 2 major-specific sequences for your intended major with a minimum 2.50 GPA. One sequence must be single-variable calculus (MATH 9A, 9B, 9C). The second sequence may be a sequence such as PHYS 40A, 40B, 40C.
- Completion of one year of college level English Composition (ENGL1A, 1B, 1C).

Major-Specific Transfer Requirements:

The following courses must be completed at the time of application:

- One course in computer programming (CS 10)
- One course in machine organization and assembly language programming (CS 61)
- One course in calculus based physics with lab (PHYS 40A)

A minimum of THREE (3) additional courses (shown below) must also be completed to form a coherent sequence. A list of potential sequences for this major is

- One course in advanced C++ programming (CS 12)
- Two courses in calculus based physics with labs (PHYS 40B, 40C)
- One course in introduction to ordinary differential equations (MATH 46)
- One course in calculus of several variables I (MATH 10A)
- One course in engineering circuit analysis I with lab (EE 1A/LA)
- One course in engineering circuit analysis II (EE 1B)

Potential Course Sequences for Electrical Engineering: three courses from CS 10 (Introduction to Computer Science for Science, Mathematics, and Engineering I), CS 12 (Introduction to Computer Science for Science, Mathematics, and Engineering II), CS 61 (Machine Organization and Assembly Language Programming), and MATH 10A (Multivariable Calculus); or PHYS 40A, 40B, and 40C (General Physics); or EE 1A/1LA, 1B (Engineering Circuits Analysis), and MATH 46 (Introduction to Ordinary Differential Equations).

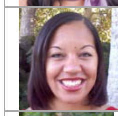
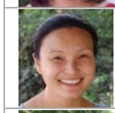
1.4 Advising and Career Guidance

The Office of Student Academic Affairs (OSA) implements and enforces academic policies developed by UCR/BCOE and its Departments/programs. There is frequent consultation and feedback between faculty and academic advisors. Below we review the mission of OSAA.

MISSION: The Office of Student Academic Affairs mission is to support engineering students in achieving their educational goals by providing guidance and services that enhance their academic development. We strive to fulfill this mission by:

- Upholding academic policies of the university, BCOE and its departments.
- Assisting students in acclimating to and navigating the academic environment, policies and expectations.
- Working intentionally to build respect, trust and cooperation with students in support of their academic success.
- Considering individual student needs while encouraging student development.
- Encouraging academic planning, self-awareness, accountability and resourcefulness.
- Helping students respond proactively and productively to issues impacting academic success.
- Committing to excellence, the academic counseling profession and continued development.

The following is a brief summary of the OSAA staff and qualifications. Note that the OSAA staff have decades of combined experience and have an exceptionally low turnover rate.

	Rod Smith	M.B.A., Business Administration, University of California Irvine, June 1994. 15 years in student affairs, 6 of those at BCOE.
	Tara Brown	Master of Science in Counseling, College Counseling/Student Affairs. California State University, Northridge, May 2002, 9 years in student affairs, 5 of those at BCOE.
	Nikki Measor	M.S. in Higher Education and Student Affairs, Indiana University, Bloomington, May 2003. 9 years in student affairs, 2 of those at BCOE.
	Amber Scott	M.S., Counseling & Guidance (Specialization in College Student Personnel), California Lutheran University, June 2007. 10 years in student affairs, 2. 5 of those at BCOE.
	Terri Phonharath	B.A., Political Science/Admin Studies, UCR, June 1998. 12 years in student affairs, 5 of those at BCOE.
	Sonia De La Torre-Iniguez	M.S., Educational Counseling and Guidance with Pupil Personnel Services Credential, CSU San Bernardino, June 2010. 9 years in student affairs, 8 of those at BCOE.
	Thomas McGraw	M.S., Sport Management, California Baptist University, June 2006. 14 years in student affairs, 9 of those at BCOE.
	Jun Wang	M.B.A., Business Administration, University of California Riverside, June 2007. 5 years in student professional development at BCOE

Professional guidance and mentoring is provided by staff (particularly, the Director of Student Professional Development, Jun Wang), the faculty, and the Career Center. The overall College philosophy that guides all interactions with students is to ensure that they are both academically and professionally prepared to become leaders in their chosen fields.

As is typical for undergraduate programs in engineering, in the past, our students spent a good portion of the first two years of their undergraduate work completing prerequisite coursework in mathematics, the sciences, and the humanities and social sciences. This created a variety of challenges: instructors in some courses lacked the engineering background necessary to motivate the students as to the importance of this prerequisite coursework; some students who are first-generation engineers or first-generation college attenders, lack the mentors or role models necessary to motivate the necessity of these background courses; also, EE students in these background course often fail to develop a clear sense of academic direction, a sense of professional pride, or the effective working relationships with their peers necessary to see them as technically strong, and as effective partners. The EE program has taken a number of steps to improve retention and this is discussed in Criterion 4 Section 4.3 under the heading of Retention.

A suite of activities supported by the college under the Professional Development Milestones program complement the program-specific content in these courses. Examples of such activities are academically-oriented workshops on time-management and study-skills; professionally-oriented activities such as mock interviews, resume writing; and, research and industrial internships. Figure 1-4 summarizes these milestones. It is strongly encouraged by the Bourns College of Engineering that all students complete at least one internship or research experience during their academic careers.

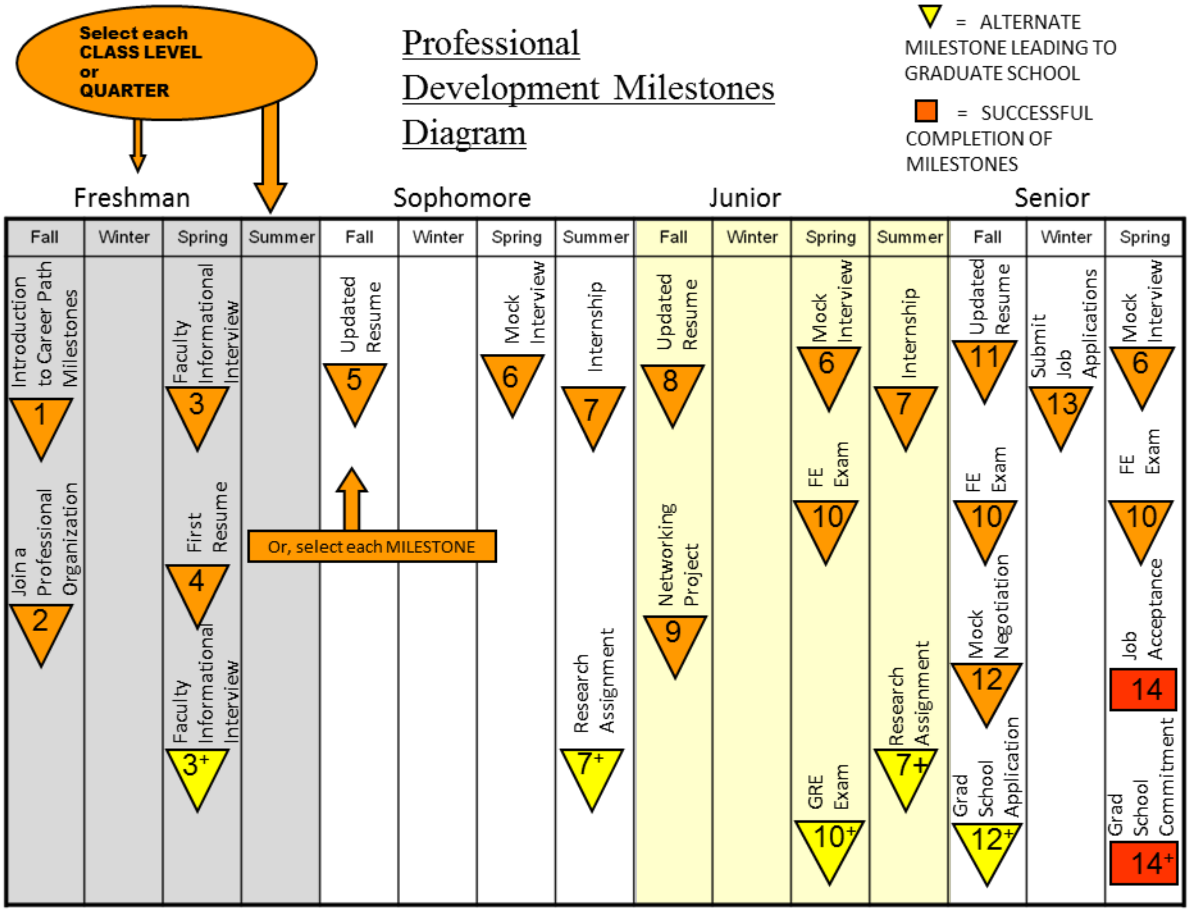


Figure 1-4: Professional Development Milestones program.

A total of 18 Student Professional Organizations exist in BCOE, and are supported financially by the College. These organizations are student-led, and are very active. Just over 800 students are active members of these organizations (roughly 40% of the students in College).

- BCOE SLC (Student Leadership Council)
- ACM (Association of Computing Machinery)
- AIChE (American Institute of Chemical Engineers)
- ASME (American Society of Mechanical Engineers)
- ASQ (American Society of Quality)
- BMES (Biomedical Engineering Society)
- EWB (Engineers Without Border)
- IEEE (Institute of Electrical and Electronics Engineers)
- IEEE EDS (Electron Devices Society)
- ION (Institute of Navigation)
- MRS (Material Research Society)

- NSBE (National Society of Black Engineers)
- OSA (Optical Society of America)
- SACNAS (Society for Advancement of Chicanos and Native Americans in Science)
- SHPE (Society of Hispanic Professional Engineers)
- SAE (Society of Automotive Engineers)
- SWE (Society of Women Engineers)
- TBP (Tau Beta Pi) – Honors Society

These organizations, under the mentorship of the Director of Student Professional Development, Mr. Jun Wang, participate in a broad range of activities during the year. A summary for the 2011-2012 academic year appears in Table 1-1. Activities of particular interest to EE students are highlighted. A summary for the 2010-2011 is available upon request.

Table 1-1. Professional development activities in BCOE during the 2011-12 academic year.

Event	**Date**	**Attendees**
Student Leadership Workshop	9/25/2011	120
Information Session: Peace Corps	9/26/2011	56
Information Session: HACU National Internship Program	9/27/2011	32
Information Session: U.S. Department of State	9/27/2011	45
Information Session: U.S. Marine Corps	9/28/2011	27
Beginning Resume Writing Workshop	10/3/2011	30
Job Search 101 Workshop	10/3/2011	42
Career Presentation by Synapse	10/5/2011	65
Internships: What, Why & How?	10/6/2011	37
Now Hiring Interns!	10/11/2011	40
Beginning Resume Writing Workshop	10/11/2011	35
Preparing for the Job Fair	10/12/2011	54
Interview Skills	10/13/2011	36
The New GRE: What does it mean for grad school applicants	10/13/2011	68
Advanced Resume Writing, featuring Cal Steel Industries, Inc.	10/13/2011	70
Careers in BioTech	10/14/2011	98
Yikes! I'm Graduating!	10/14/2011	26
Resumania, Featuring Target	10/17/2011	30
Law School Forum	10/17/2011	35
Why Can't I Find a Job?	10/17/2011	42
Google Day at BCOE	10/17/2011	135
Resumania, Featuring Sherwin Williams	10/18/2011	25
Careers at EPA Info Session	10/18/2011	67
Career Expo	10/19/2011	
Visit at NAVSEA NSWC Corona	10/20/2011	25

Guest Speakers from NASA/Carnegie Mellon Silicon Valley	10/20/2011	59
Part-Time Job Search/Beginning Resume Writing Workshop	10/20/2011	23
Information Session: USMC Aviation	10/20/2011	25
Making Professional Connections, Featuring: Target	10/24/2011	28
LinkedIn 101: Networking Professionally Online	10/26/2011	30
Graduate & Professional School Information Day	10/27/2011	
Guest Speakers from Northrop Grumman Aerospace Systems	10/27/2011	78
Interview Skills, Featuring: Aerotek	10/31/2011	35
Law School Information Day	11/1/2011	
Advanced Resume Writing, featuring Kohl's	11/2/2011	21
Interview Skills, Featuring: Best Buy	11/7/2011	27
Part-Time Job Search/Beginning Resume Writing Workshop	11/7/2011	32
Jump Start to Grad School, Featuring: Kaplan	11/7/2011	36
Careers in Internet Retail	11/7/2011	25
SWE Female Engineers Guest Speaker Panel	11/7/2011	67
ASQ Biomedical Industrial Panel	11/7/2011	75
Information Table: Peace Corps	11/8/2011	29
Engineer Your Future: Careers in Mechanical Eng (Northrop Grumman)	11/8/2011	56
INROADS Meeting with BCOE students	11/8/2011	102
Internships: What, Why & How?	11/9/2011	23
Information Session: CIA	11/9/2011	46
Undergraduate Research Opportunities Workshop	11/14/2011	45
Yikes! I'm Graduating!	11/14/2011	19
Now Hiring Interns!	11/15/2011	23
Information Session: 50th Anniversary of Peace Corp	11/15/2011	34
Career Marathon (resume reviewing)	11/16/2011	60
AICHE Presentation/Guest Speakers from Energy Industry	11/18/2011	76
Visit at K&N Engineering	11/19/2011	25
INROADS Workshop & Interview with students	12/10/2011	32
Visit at Luxfer Cylinder Company	12/14/2011	15
Information Table: Graduate School Prep, featuring: Princeton Review	1/4/2012	36
Internships: What, Why & How?	1/17/2012	27
Part-Time Job Search Webinar	1/17/2012	33
College to Careers: BCOE Alumni Panel	1/17/2012	65
Career Station	1/18/2012	21
Beginning Resume Writing FYSS	1/18/2012	22

Prepare For Engineering & Technical Career Fair	1/19/2012	97
Interview Skills Workshop	1/24/2012	36
Career Station	1/24/2012	12
LinkedIn: Your Professional Version of Facebook	1/24/2012	47
Now Hiring Interns: WINternships Edition	1/24/2012	25
SHPE & NSBE Meeting with EPA	1/24/2012	66
Information Table: The Princeton Review	1/25/2012	23
ENGINEERING & TECHNICAL CAREER FAIR	1/25/2012	
Career Station	1/25/2012	14
Why Can't I Find a Job?	1/25/2012	29
Advanced Resume Writing	1/26/2012	38
Career Station	1/26/2012	24
How to Perfect Your 30-Second Elevator Speech	1/26/2012	50
Making Professional Connections	1/27/2012	31
Career Station	2/1/2012	12
Career Marathon (resume reviewing)	2/1/2012	36
ASQ Mock Interviews for Engineering Students	2/2/2012	87
Trip to Life Technology	2/3/2012	34
Yikes! I'm Graduating!	2/7/2012	21
Visit to Meggitt	2/8/2012	15
Information Table: The Princeton Review	2/8/2012	20
Career Station	2/8/2012	10
Undergraduate Research Opportunities Workshop	2/9/2012	42
Non-Clinical Health Profession Panel	2/9/2012	48
Google Day at BCOE	2/9/2012	111
Jump Start to Medical School, Featuring: Kaplan	2/9/2012	21
iStartStrong: Connection You to Satisfying Careers	2/13/2012	16
AICHE Guest Speakers from Fluor Corp	2/13/2012	79
Conversation Skills	2/14/2012	14
Beginning Resume Writing	2/15/2012	28
Career Station	2/15/2012	13
Visit to Circor	2/15/2012	10
Agricultural Careers Dinner & Industry Professionals Networking Event	2/15/2012	85
Internships: What, Why & How?	2/16/2012	20
GOVERNMENT AND NON-PROFIT JOB FAIR	2/16/2012	
SWE Resume Workshop	2/21/2012	45
Career Station	2/22/2012	15
Presentation Skills	2/22/2012	32
Now Hiring Part-Time Jobs	2/23/2012	22
Making Professional Connections	2/23/2012	26

Beginning Resume Writing	2/27/2012	20
Former Interns Tell All	2/28/2012	54
Interview Skills	2/28/2012	16
BCOE IMPACT Mentoring Meeting	2/28/2012	82
Information Table: The Princeton Review	2/29/2012	19
Career Station	2/29/2012	18
Advanced Resume Writing	2/29/2012	28
Are You Really Ready to Work? Workplace Etiquette	3/1/2012	46
Careers at Air Force	3/1/2012	24
BCOE IMPACT Mentoring Meeting	3/1/2012	78
ACM Guest Speaker from Western Digital	3/5/2012	56
GRADUATE VIRTUAL FAIR	3/7/2012	
Making Professional Connections	3/7/2012	26
Yikes! I'm Graduating!	3/7/2012	24
Visit at JPL	3/8/2012	18
Part-Time Job Search/Beginning Resume Writing	3/8/2012	31
Interview Skills	3/13/2012	22
Why Can't I Find a Job?	3/14/2012	25
Non-Academic Job Search (Grad Students Only)	3/15/2012	60
Information Table: Kaplan Test Prep	4/4/2012	21
Information Session: Target Distribution	4/5/2012	32
Yikes! I'm Graduating!	4/9/2012	17
Part Time Job Search/Beginning Resume Writing Webinar	4/9/2012	20
Prepare For Spring Job Fair and Dress for Success	4/9/2012	67
Careers in Public Service Webinar	4/10/2012	52
Internships: What, Why & How Webinar	4/10/2012	21
Beginning Resume Writing	4/10/2012	19
Career Station	4/11/2012	26
SPRING JOB FAIR: CAREER NIGHT	4/11/2012	
What Can You Do Besides Becoming a Doctor?	4/12/2012	30
Choosing a Health Professions School	4/12/2012	32
Hands-On Healthcare: Volunteer Opportunities	4/12/2012	41
HEALTH PROFESSIONS SCHOOL FAIR	4/12/2012	
Advanced Resume Writing Webinar	4/16/2012	15
Conversation Skills	4/16/2012	17
Interview Skills	4/17/2012	13
Making Professional Connections	4/17/2012	20
Job Search Skills	4/17/2012	22
Information Table: Peace Corps	4/18/2012	23
Information Table: Kaplan Test Prep	4/18/2012	14

Career Station	4/18/2012	12
Careers at NAVY Info Session	4/19/2012	17
Entrepreneur Career Panel: Starting Your Own Business	4/19/2012	115
Work Green, Earn Green: Careers that Save the Planet	4/20/2012	46
Information Session: City Year Los Angeles	4/20/2012	48
LinkedIn: Network & Get Recruited, Featuring: Fresh & Easy	4/23/2012	68
Now Hiring Part-Time Jobs	4/24/2012	40
Career Station	4/25/2012	25
Job Search (Grad Students Only)	4/25/2012	22
Now Hiring Interns	4/25/2012	24
Information Table: Across the Pond	4/26/2012	23
Visit at Chevron	4/27/2012	36
Internships: What, Why & How	4/30/2012	20
LinkedIn Webinar: Your Professional Version of Face-book	4/30/2012	14
Interview Skills, Featuring: Consolidated Electrical Dis-tributors	5/1/2012	42
Yikes! I'm Graduating!	5/1/2012	35
Jump Start to Law School, Featuring: Kaplan	5/1/2012	22
Advanced Resume Writing, Feat: California Steel Indus-tries	5/2/2012	29
Career Station	5/2/2012	15
Job Search Skills	5/3/2012	12
Interview Skills	5/3/2012	16
Resume & CV Writing (Grad Students Only)	5/8/2012	21
Career Station	5/9/2012	13
Beginning Resume Writing	5/9/2012	12
Interview Skills	5/10/2012	17
Job Search Skills Webinar	5/10/2012	20
Yikes! I'm Graduating!	5/14/2012	27
Career Marathon	5/16/2012	36
Information Session: Peace Corps	5/16/2012	9
Former Interns Tell All	5/16/2012	43
Careers in Defense Industries	5/16/2012	84
LAST CHANCE JOB FAIR	5/17/2012	
Seasonal Job Search/Beginning Resume Writing	5/21/2012	20
Advanced Resume Writing	5/22/2012	24
Conversation Skills	5/22/2012	31
Job Search Skills	5/23/2012	14

A summary of the range of Professional Development, Mentoring, and Success program in BCOE appears in Figure 1-5.

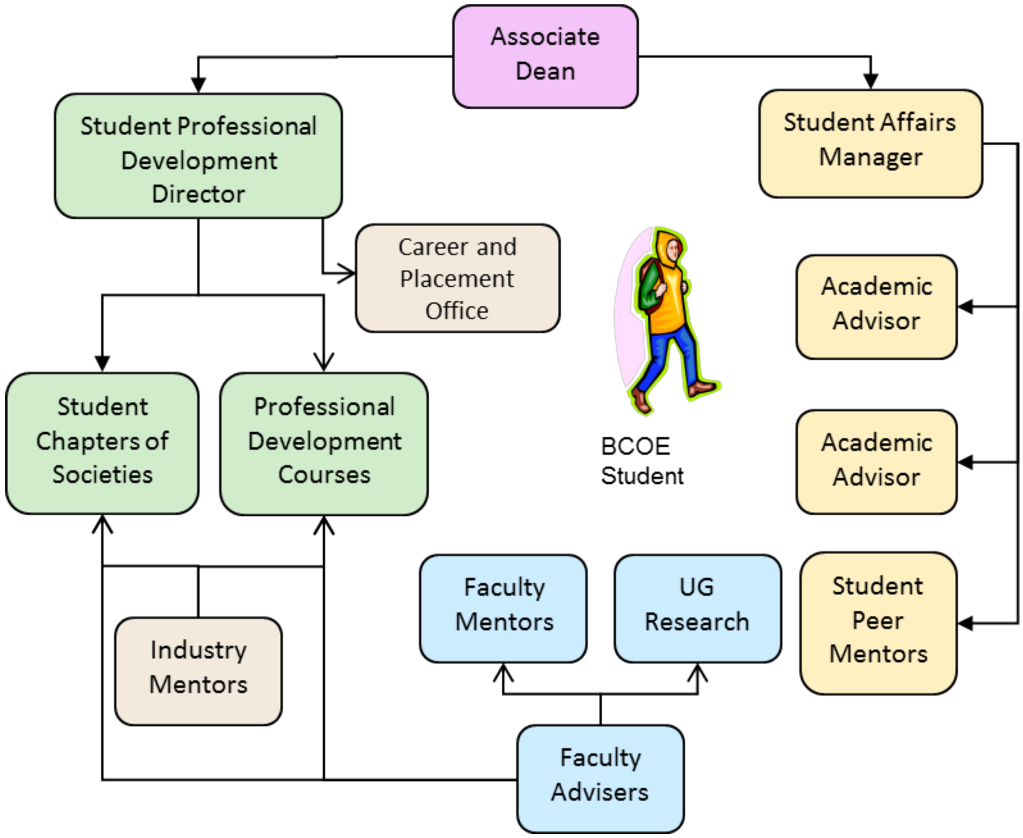


Figure 1-5. Professional development, placement, and success programs.

1.4.1 IEEE at UCR

A main EE oriented club is the IEEE. It strives to provide students with professional development and academic achievement opportunities. Activities include hands-on robotics workshops, allowing students to apply their in-class knowledge; intramural sports to encourage interaction with campus society; IEEE national competitions to interact and compete with IEEE members from other schools; professional development events to facilitate the transition from school to the workforce; and outreach events such as the annual Boy Scouts Merit Badge days to teach the next generation in the local community about electrical engineering. Currently IEEE at UCR has over 120 student members with consist of both undergraduate and graduate students. More info available at: http://ieee.ee.ucr.edu/.

IEEE Workshops and Non-credit Student Projects

IEEE is one of the most active student organizations at UCR. Their webpage describes their various activities, which includes such community service as the Boy Scout Merit Badge Day.

One of the most important activities of IEEE is its organization of workshops to teach EE projects skills. The workshops are motivated by the fact that many freshmen have no prior knowledge of EE projects or project skills. As they get involved with projects, the mathematical, scientific, and engineering skills that they learn in class are seen in a different light, not only as esoteric theories, but as practical tools. The workshops are lead and taught almost entirely by IEEE student members. They are coordinated with the EE Associate Development Engineer (Elmar Palma) and draw on the resources of the EE shop.

The IEEE student workshops are not for credit. The specific schedule each year is determined by the level of student interest. The workshop schedule for the 2011/2012 academic year is shown below and is typical.

	Beginners	Intermediate	Advanced	Micromouse
Fall	1 hr/week	1 hr/week	3 hrs/week	N/A hr/week
Winter	1 hr/week	1 hr/week	3 hrs/week	N/A hr/week
Spring	1 hr/week	-	3 hrs/week	N/A hr/week

Typical topics for the workshops are as follows:

<u>Beginner Outline</u> Equipment Orientation (Safety) Resistors, Ohm's Law, Power, Resistors in Series Resistors in Parallel LEDs, PWM and Analog Voltages Transistors Final Analog Motor Control Circuit	<u>Intermediate Outline</u> Blinking 8 LEDs Analog to Digital Serial I/O
<u>Advanced Outline</u> Datasheet and Research Techniques H-bridge and Unknown DC Motor IR LED Sensors	<u>Micromouse Outline</u> Build a Micromouse

Students completing the workshops are ready to volunteer in various research labs across campus. Many work on personal projects in the EE shop in collaboration with the EE Associate Development Engineer (Elmar Palma).

The IEEE organization has won a number of awards. These include:

- BCOE Most Outstanding Student Organization – 2007-08
- BCOE Most Competitive Student Organization – 2008-09
- BCOE Most Outstanding Professional Development Organization – 2009-10
- BCOE Best Outreach Event – IEEE Merit Badge Days – 2010-11
- BCOE Most Competitive Student Organization – 2011-12

1.4.2 Undergraduate Research

In addition, the College has a very active Undergraduate Research program. Faculty are very active participants in undergraduate research. Last year, 60 of the 83 faculty in BCOE were research mentors for undergraduates. Over 250 undergraduates worked with faculty on research projects. This research has resulted in a significant number of publications and research presentations. For example, in the 2010 Southern California Conference on Undergraduate Research (SCCUR), 18 of the 24 research presentations from UCR were by BCOE students. For the second year in a row, BCOE students made more presentations at SCCUR than students from any other engineering college in Southern California. Specific to the EE program in the present year, 27 UG students are participating in UG research projects (4 sophomores, 8 juniors, and 19 seniors). Some of them have published in the top venues. For example:

N. Amos, R. Fernandez, R. Ikkawi, M. Shachar, J. Hong, B. Lee, D. Litvinov, and S. Khizroev, "Ultra-High Coercivity Magnetic Force Microscopy Probes to Analyze High-Moment Magnetic Structures and Devices," *IEEE Magnetics Letters* 1, 6500104 (2010).

M. Relles, E. Ngan, S. Tlelo-Cuautle, S. Tan, C. Hu, W. Yu and Y. Cai, "Statistical Extraction and Modeling of 3D Inductance with Spatial Correlation," IEEE International Workshop on Symbolic and Numerical Methods, Modeling and Applications to Circuit Design (SM2ACD), Tunisia, October 5-6, 2010.

B. Song, T. Jeng, E. Staudt, A. Roy-Chowdhury, "A Stochastic Graph Evolution Framework for Robust Multi-Target Tracking," European Conference on Computer Vision, 2010. (Acceptance rate 27%)

A number of our students have also won awards at design competitions. A few examples are below.

April 17, 2010, BCOE students Alex Eisner and Andrew Juarez finished second in the MicroMouse competition held the regional meeting of the IEEE at California State University, Northridge.

April 29th, 2009, IEEE Region 6 Southwest Area Meeting, University of California, San Diego, IEEE Region 6 Micromouse Competition (Won 1st Place and 3rd Place in Southwest Region).

Oct 28th, 2007, UC Riverside Electrical Engineering students were invited to travel to Taiwan to compete in the annual MicroMouse Robotics competition on Oct. 28 at the University of South Taiwan.

1.5 Work in Lieu of Courses

Credit is awarded for selected International Baccalaureate Advanced Placement courses taken in high school, in accordance with the charts on pages 28-31 in the General Catalog for the University of California, Riverside.

Internships and independent study courses may not be used to satisfy College subject requirements, as per the following College regulation:

> **ENR3.2.8.** Internships and independent study courses may not be used to satisfy College subject requirements. (En 25 May 95) (Renumbered & Am 25 May 00)

Credit by Examination is awarded subject to the following College Regulations:

> **ENR2.5.1.** A student who wishes to have the privilege of examination for degree credit must be in residence and not on academic probation.
> **ENR2.5.2.** Arrangements for examination for degree credit must be made in advance with the student's faculty adviser. The approval of the faculty adviser, the Dean of the college, and that of the instructor who is appointed to give the examination, is necessary before the examination can be given.
> **ENR2.5.3.** The results of all examinations for degree credit are entered on the student's record in the same manner as for regular courses of instruction.

1.6 Graduation Requirements
The following are the graduation requirements for students receiving the Bachelor of Science degree in the EE program.

University Requirements
Student must meet campus general education requirements. The list of courses that meets this criterion is given is Table 5-3.

College Requirements
1. Lower-division requirements (74 units)
   a) One course in the biological sciences chosen from an approved list.
   b) CHEM 001A, CHEM 01LA (General Chemistry).
   c) CS 010 (Introduction to Computer Science for Science, Mathematics, and Engineering I), CS 013 (Introductory Computer Science for Engineering Majors), CS 061 (Machine Organization and Assembly Language Programming).
   d) EE 001A (Engineering Circuit Analysis I), EE 01LA (Engineering Circuit Analysis I Laboratory), EE 001B (Engineering Circuit Analysis II), EE 010 (Introduction to Electrical Engineering), EE 020 (Linear Methods for Engineering Analysis and Design Using MATLAB).
   e) MATH 008B (Introduction to College Mathematics for the Sciences) or MATH 009A (First-Year Calculus); MATH 009B (First-Year Calculus), MATH 009C (First-Year Calculus), MATH 010A (Calculus of Several Variables), MATH 010B (Calculus of Several Variables), MATH 046 (Introduction to Ordinary Differential Equations).
   f) PHYS 040A, PHYS 040B, PHYS 040C (General Physics).

2. Upper-division requirements (82 units)
   a) EE 100A (Electronic Circuits), EE 100B (Electronic Circuits), EE 105 (Modeling and Simulation of Dynamic Systems), EE 110A (Signals and Systems), EE 110B (Signals and Systems), EE 114 (Probability, Random Variables, and Random Processes in Electrical Engineering),, EE 115 (Introduction to Communication Systems), EE 116 (Engineering Electromagnetics), EE 132 (Automatic Control), EE 141 (Digital Signal Processing), EE 175A (Senior Design Project), EE 175B (Senior Design Project).

b) CS 120A/EE 120A (Logic Design), CS 120B/EE 120B (Introduction to Embedded Systems).
c) ENGR 180W (technical Communication).
d) Twenty (20) units of technical electives (chosen with the approval of a faculty advisor) from CS 122A (Intermediate Embedded and Real-Time Systems), CS 130 (Computer Graphics), CS 143/EE 143 (Multimedia Technologies and Programming), CS 161 (Design and Architecture of Computer Systems), CS 168 (Introduction to Very Large Scale Integration (VLSI) Design); EE 117 (Electromagnetics II), EE 128 (Data Acquisition, Instrumentation, and Process Control), EE 133 (Solid State Electronics), EE 134 (Digital Integrated Circuit Layout and Design), EE 135 (Analog Integrated Circuit Layout and Design), EE 136 (Semiconductor Device Processing), EE 137 (Introduction to Semiconductor Optoelectronic Devices), EE 138 (Electrical Properties of Materials), EE 139 (Magnetic Materials), EE 140 (Computer Visualization), EE 144 (Introduction to Robotics), EE 146 (Computer Vision), EE 150 (Digital Communications), EE 151 (Introduction to Digital Control), EE 152 (Image Processing), EE 160 (Fiber-Optic Communication Systems).

The choice of technical electives must ensure that the upper division requirements include at least one coherent sequence of at least three (3) electrical engineering courses to ensure depth in one area of electrical engineering.

Transcripts of Recent Graduates

The program will provide transcripts from some of the most recent graduates to the visiting team along with any needed explanation of how the transcripts are to be interpreted. These transcripts will be requested separately by the team chair.

1.7 Diversity in the Bourns College of Engineering

The Bourns College of Engineering is proud to be one of the most diverse engineering colleges in America. The number of domestic undergraduates from underrepresented backgrounds jumped 95.6% from the fall of 2006 to the fall of 2010 (the most recent academic year for which full data are available). The data are summarized in Table 1-2. In recognition of our efforts to recruit and retain students from diverse backgrounds to engineering, ABET awarded the Bourns College of Engineering the 2009 Claire Felbinger Award for Diversity Our citation read: “In recognition of extraordinarily successful initiatives for recruiting undergraduate and graduate students from diverse and disadvantaged backgrounds, retaining them though the bachelor's degree, and advancing them to graduate studies and careers in engineering." Our faculty and staff truly appreciate this recognition of their efforts by ABET.

Table 1-2. The number of domestic undergraduates from underrepresented backgrounds in the Bourns College of Engineering has nearly doubled since 2006.

	Fall 2006	Fall 2007	Fall 2008	Fall 2009	Fall 2010
Undergraduate: % domestic underrepresented	27%	29%	31%	31%	33%
Undergraduate: # domestic underrepresented	340	377	449	521	665
Undergraduate: % domestic female	12%	12%	15%	17%	17%
Undergraduate: # domestic female	151	156	222	291	348
Graduate: % domestic underrepresented	16%	21%	18%	16%	17%
Graduate: # domestic underrepresented	14	24	27	24	32

CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

Mission Statement
The University of California, Riverside serves the needs and enhances the quality of life of the diverse people of California, the nation and the world through knowledge – its communication, discovery, translation, application, and preservation. The undergraduate, graduate and professional degree programs; research programs; and outreach activities develop leaders who inspire, create, and enrich California's economic, social, cultural, and environmental future.

With its roots as a Citrus Experiment Station, UC Riverside is guided by its land grant tradition of giving back by addressing some of the most vexing problems facing society. Whether it is assuring a safe, nutritious, and affordable food supply; stimulating the human mind and soul through the humanities and arts; or finding solutions to the profound challenges in education, engineering, business, healthcare, and the environment, UC Riverside is living the promise.

The mission of the Bourns College of Engineering is to:

- Produce engineers with the educational foundation and adaptive skills to serve rapidly evolving technology industries;
- Conduct nationally recognized engineering research focused on providing a technical edge for the United States;
- Contribute to knowledge of both fundamental and applied areas of engineering;
- Provide diverse curricula that will instill in our students the imagination, talents, creativity, and skills necessary for the varied and rapidly changing requirements of modern life;
- Enable our graduates to serve in a wide variety of other fields that require leadership, teamwork, decision-making and problem-solving abilities; and
- Be a catalyst for industrial growth in Inland Southern California.

The vision of the Bourns College of Engineering is to become a nationally recognized leader in engineering research and education.

Program Educational Objectives
The Program Education Objectives (PEOs) are listed below.

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

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

success in a chosen profession or vocation as evidenced by:
- career satisfaction
- promotions/raises (e.g. management leadership positions or distinguished technical positions)
- professional visibility (e.g., publications, presentations, patents, inventions, awards)
- professional responsibilities (e.g. professional registration, professional mentoring, professional society membership and offices)
- entrepreneurial activities
- consulting activities

contributions to society as evidenced by:
- Leadership roles
- Public service
- Mentoring / outreach activities
- Volunteer service

The PEOs are structured into three main objectives, with various specific example pieces of measurable evidence for each. It is not expected that students will achieve all of the three main items. Instead, the PEOs are designed to meet the needs of students with different interests within the EE program. Some of our students go for advanced degrees and the first set of PEOs is most relevant to them. The second set is designed for those planning to enter the workplace (industry/government/non-profit) immediately after graduating. We expect most of our students to have made some societal contributions in 3-5 years after graduating.

With advice from the BOA and faculty, it has been decided that minimum expectation level is the attainment of at least one of the evidence bullets in two categories.

The PEOs are publicly available at http://www.ee.ucr.edu/current-students/vopeo.html.

Consistency of the Program Educational Objectives with the Mission of the Institution
The PEOs are clearly consistent with the mission of the EE program, which is the same as that of the Bourns College of Engineering. The first PEO, *success in post-graduate studies*, is aligned with the mission to conduct nationally recognized research and contribute to knowledge in the

various areas of engineering. The second objective, *success in one's chosen career*, is in line with the mission to provide the foundational skills and creative spirits necessary for a rapidly developing industry, the educational background necessary for success, and the development of skills such as teamwork and problem-solving. *Societal contributions* are important for both the PEOs and the mission as evidenced by the need to develop leadership qualities and contribute towards the development of the local region.

Program Constituencies

The various program constituencies are faculty, students, alumni and Board of Advisors (BOA). They represent students, industry, government and academia. The PEOs are most closely aligned to the needs of the students, who become our alumni and are employed by the entities represented by the BOA. Our overall goal is to train students to be able to pursue higher education, to be successful in their profession, and to make positive contributions to society. We also want them to be good citizens and become successful entrepreneurs when opportunity presents. The PEOs were designed in collaboration with and are evaluated by students, faculty, and the EE BOA. Attainment of the PEOs is mainly evaluated based on feedback from the alumni via surveys (conducted every 2-3 years, most recently in 2009 and 2012) on how well they are doing and the role their college experience had on their current status. This feedback provides guidance to the faculty in assessing how well these PEOs are met. Periodic evaluation of the PEOs, based on information about our alumni performance, allows the faculty to enact changes to the program. The satisfaction of the PEOs meets the needs of the faculty to involve students in world-class research in their labs and train them for a fast-changing workplace. The Board of Advisors was instrumental in designing the PEOs and they have been asked to suggest modifications periodically. Successful implementation of the PEOs provides the Board of Advisors, drawn mostly from industry, with a talented pool of engineers.

Process for Revision of the Program Educational Objectives

The PEOs were initially approved in May-June 2007 with inputs from the faculty, Board of Advisors (many of them are employers of our students, see Table BG-1), and students. There were a number of iterations made based on these inputs. An initial set of PEOs was proposed by the faculty in March 2007, which was then presented to the BOA at their annual meeting on May 17, 2007. They liked the PEOs overall, but proposed some change in the language. The current students were also provided the list of PEOs after this stage and they had no suggestions for changes. Taking the entire set of comments into account, the faculty voted on and approved the final set of PEOs in June 2007.

The PEOs are periodically reviewed by the faculty and by the BOA at the annual meeting.

- At its meeting on May 6, 2011, the BOA reviewed, but did not suggest any changes to the PEOs.
- The faculty last reviewed the PEOs in February 2012. No changes were required.
- At its meeting May 10, 2012, the BOA suggested two changes. First, that the PEO statement be revised to make clear that students were not expected to satisfy all three of the major objectives. Second, that the items of evidence be clearly indicated to be examples.
- At the EE faculty meeting on May 16, 2012, the changes suggested by the BOA were discussed and accepted by the faculty.

- The EE program will also contact students to get their input. Assuming that they will not have any issues, these changes will be incorporated into the catalog description through the proper university channels.

Surveys of the alumni were conducted in 2009 and 2012 to get their input on how the program was performing with respect to the PEOs. A summary of the results of the survey is available in Appendix F. While the results were mostly satisfactory, there were certain areas where it was felt that more exposure could have been provided in the courses. This was also in line with feedback obtained on the student outcomes (see Criterion 3 for details). None of the constituencies felt that there was a need to change the PEOs. However, based partially on the feedback received in evaluating the PEOs, certain changes were made to the course structure, especially the introduction of new courses related to computer programming, introduction to linear algebra and MATLAB and energy and power systems. The implementation of these changes is detailed in the section on Continuous Improvement (Criterion 4).

CRITERION 3. STUDENT OUTCOMES

3.1 Student Outcomes

The following are the a-k Student Outcomes.

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

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

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

(d) an ability to function on multidisciplinary 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.

The Student Outcomes (SOs) are publicly available on the EE website http://www.ee.ucr.edu/current-students/vopeo.html. Instructors are advised to provide this to the students at the beginning of the course when the syllabus is distributed. The instructors are also advised to let the students know which of these SOs are relevant to the course.

3.2 Relationship of Student Outcomes to Program Educational Objectives

The Student Outcomes have a direct bearing to the PEOs. Table 3-1 below explains this relationship. Each outcome directly contributes to multiple PEOs.

Table 3-1. Relationship of Student Outcomes to PEOs.

Student Outcomes	Program Educational Objectives
a. Ability to apply knowledge of mathematics, science, and engineering	Success in post-graduation studies, as well as success in the engineering profession.
b. Ability to design and conduct experiments, as well as analyze and interpret data	Success in post-graduation studies, as well as success in the engineering profession.
c. Ability to design a system, component, or process to meet desired needs	Success in the engineering profession, as well as success post-graduation studies.
d. Ability to function on multidisciplinary teams.	Success in the engineering profession, as well as success post-graduation studies.
e. Ability to identify, formulate, and solve engineering problems	Success in both post-graduation studies and the engineering profession.
f. Understanding of professional and ethical responsibility	Success in post-graduation studies, professional life, as well as societal contributions.
g. Ability to communicate effectively	Success in post-graduation studies, professional life, as well as societal contributions.
h. Broad education necessary to understand the impact of engineering solutions in a global and societal context	Success in post-graduation studies, professional life, as well as societal contributions, especially with regards to leadership roles and public service.
i. Recognition of the need for and an ability to engage in lifelong learning	Success in both post-graduation studies and the engineering profession.
j. Knowledge of contemporary issues	Absolutely essential for societal contributions, and necessary for success in post-graduation studies and professional practice.
k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	Success in the engineering profession, as well as success post-graduation studies.

CRITERION 4. CONTINUOUS IMPROVEMENT

4.1 Program Educational Objectives

The achievement of the PEOs is evaluated by the relevant constituents as shown below.

Alumni – Since the PEOs are expected to be achieved by the students a few years after graduation, the alumni input is the most essential. This is obtained through a survey conducted every two to three years. The last two surveys were conducted in 2009 and 2012. The Chair sends out the surveys by email to the alumni based on the latest contact information that is available. In 2009, we received 24 responses, and in 2011 we received 17. A summary of the survey results is shown in Appendix F. The survey consists of questions that directly measure different aspects of the PEOs (e.g., whether the alumnus has completed a graduate degree, whether the alumnus has completed a professional certification), as well as more indirect questions like how well they were prepared for their career choice.

Board of Advisors (BOA) – The BOA meets annually. Review of the PEOs and the extent to which the BOA feels the PEOs are being achieved are on each meetings agenda. The last two meetings were in May 2011 and May 2012. The BOA provides its input on how well the PEOs are being achieved based on their experience in working with UCR graduates and comparing them with students from other institutions. They also comment on how well the academic structure of the program meets the current technological needs. The BOA consists of many members who are from organizations that hire our students. Therefore, BOA inputs are considered as providing voice to the employers of our graduates. [2]

Faculty – The inputs received from the alumni and Board of Advisors are analyzed by the undergraduate committee. This input is combined with other curricular feedback that the committee has received over the course of the year. A summary is then presented to the faculty for discussion along with a list of suggested modifications to be implemented to better achieve the PEOs. Below in Section 4.3, we provide a detailed list of the changes that have been made. Any changes discussed in the faculty meetings are documented in the faculty meeting minutes.

4.1.1 Summary of Alumni Survey

The questions on the alumni survey are designed to measure directly the three broad aspects of the PEOs – success in higher education, success in chosen career, and being a good citizen. Below is a brief summary of the results, more details of which are available in Appendix G.

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[2] When the BOA was originally constituted, the EE program did not have alumni sufficiently established in the profession to be placed on the BOA. Therefore, the members of the BOA were invited from the companies that we desired and expected to hire our grads, with the intention that such a BOA would help to build a program with alumni shaped in the manner that they desired. This has been successful. The EE program is now at a stage where it has a number of alumni sufficiently well established in their careers that they are suitable for inclusion on the BOA. Finding and inviting appropriate alumni to serve on the BOA is a near-term goal.

- Success in Higher Education (Questions 2-12): About 50% of the respondents mentioned that they went for a higher degree with most doing an MS, other subsequent degrees included the MBA and PhD.

- Success in chosen career (Questions 13-25): The distribution of careers among our graduates was along expected lines of engineering development, support and sales. Satisfaction within the chosen career was generally quite high.

- Good citizenship (Question 26): Most of our graduates have performed some activities related to public and community service and demonstrated leadership roles.

Based on the feedback received from the alumni and BOA, as well as the expectations set forth above, following were the conclusions made regarding satisfaction of the PEOs.

- There did not seem to be any major issues related to career satisfaction or the preparation received while at UCR.
- Among the students who chose an industry career, the vast majority were working in engineering related areas, where their academic preparation was most useful.
- About 50% of the alumni who responded to the survey pursued graduate studies, which was deemed to be very satisfactory.
- Whether in higher studies or in industry, a good number of the alumni felt that they were contributing positively as evidenced by publications, presentations, patents, awards, etc.
- About one-third of the alumni surveyed were involved in the community. Some (e.g., Deep Shah, Sean Dowden, Craig Nolen) of them have come back to mentor and give seminars to our current students.
- The Senior Design Project was very highly appreciated. It was felt that the role of community involvement and ethical responsibilities could be highlighted more in the senior design projects, given the high interest in this course among the students.
- Some BOA members and faculty suggested that the students would be even better prepared if they were provided more exposure to subjects of critical importance (e.g. Matlab and linear algebra) earlier in the program than is done at present.
- Two important areas for further improvement were programming skills and knowledge of energy-related technologies.

Changes have been implemented based on these inputs as discussed in Part C below.

4.2 Student Outcomes

The attainment of the Student Outcomes is assessed mainly through two mechanisms, as well as the Senior Exit Surveys.

- Measurement of student performance in a course instrument that is particularly targeted towards the Student Outcome. All Student Outcomes are covered in the required courses and hence this provides a measurement that is valid for the entire student cohort.
- Student surveys at the end of each course that ask students to provide their feedback on a sliding scale regarding the attainment of each Student Outcome relevant to the course.

Both are carried out for each course every time it is offered. The data collected is documented in the course folder for each course. The analysis of the results is available in a folder specific to ABET and accessible to all faculty.

In addition, the Senior Exit Surveys provide additional feedback on how the Student Outcomes were met over the entire curriculum. Each outcome is mapped to a set of questions and the responses to the questions are used as the feedback.

Below, we explain the details of the process of measuring and analyzing the student outcomes.

Each EE course is mapped to a set of Student Outcomes, such that all the Student Outcomes are covered completely by the core courses. This ensures that all students meet all the Student Outcomes. Table 4-1 shows the mapping. Note that a course can cover more Student Outcomes than indicated here. However, the program decided to focus on the top 2-3 most closely related Student Outcomes in each lecture courses. The Senior Design project covers a larger set of Student Outcomes. The reasoning behind this decision was based on the fact that although some Student Outcomes may be somewhat related, it is very hard to directly measure more than 2-3 Student Outcomes in most courses.

For each course and each Student Outcome, the instructor identifies at least one instrument (e.g., HW problem, quiz, exam question) that directly measures performance on that Student Outcome. The results on that instrument are maintained separately and analyzed by the instructor at the end of the course to measure how well the Student Outcome is attained. The performance on each Student Outcome, averaged over all the courses related to it, is analyzed by the department ABET committee.

To decide which Student Outcomes are most relevant to a course, a mapping from the Course Objectives to the Student Outcomes is done through a Course Matrix. Table 4-2 provides an example of a Course Matrix of EE114 – Probability, Random Variables and Processes in Electrical Engineering.

Table 4-1. Mapping of Student Outcomes to courses.

Course#:	**Course Name:**	**Student Outcomes**										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
Required												
EE-1A	Engineering Circuit Analysis I	X	X									
EE-1B	Engineering Circuit Analysis II	X	X									
EE-100A	Electronic Circuits	X	X									
EE-100B	Electronic Circuits	X	X									
EE-105	Modeling and Simulation of Dynamic Systems	X				X						
EE-110A	Signals and Systems	X				X						
EE-110B	Signals and Systems	X				X						
EE-114	Probability, Random Variables, and Random Processes in EE	X				X						
EE-115	Introduction to Communication Systems		X			X						
EE-116	Engineering Electromagnetics	X				X						
EE-120A	Logic Design			X	X							
EE-120B	Introduction to Embedded Systems			X	X							
EE-132	Automatic Control	X				X						
EE-141	Digital Signal Processing	X				X						
EE-175 A/B	Senior Design Project	X	X	X	X	X	X	X	X	X	X	X
Electives												
EE-143	Multimedia Tech. and Programming		X	X								
EE-117	Electromagnetics II	X				X						
EE-128	Data Acquisition		X	X								
EE-133	Solid-State Electronics	X				X						
EE-134	Digital Integrated Circuit Layout and Design			X		X						
EE-135	Analog Integrated Circuit Layout and Design			X		X						
EE-136	Semiconductor Device Processing			X		X						
EE-137	Introduction to Semiconductor Optoelectronic Devices											
EE-138	Electrical Properties of Materials	X										
EE-139	Magnetic Materials	X				X						
EE-140	Computer Visualization				X	X						
EE-144	Introduction to Robotics		X	X								
EE-146	Computer Vision	X	X									
EE-150	Digital Communications	X	X									
EE-151	Introduction to Digital Control	X				X						
EE-152	Image Processing	X	X									
EE-160	Fiber-Optic Communication Systems		X	X								

Table 4-2. Example of mapping of Course Objectives to Student Outcomes for a required course (in this case, EE114 – Probability, Random Variables, and Processes in Electrical Engineering.

Item	**STUDENT OUTCOME-RELATED COURSE OBJECTIVES**	**STUDENT OUTCOMES**										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Introduction to basic concepts of probability	1										
2	Introduction to basic concepts of random variables	1										
3	Understanding the role of probability and statistics in real life applications	1										
4	Applications of probability and random variables in electrical and computer engineering.					1						
5	Introduction to multiple random variables, joint distributions, independence and correlation	1										
6	Introduction to random processes and their applications	1										
7	Ability to independently solve problems in probability, random variables and random processes	1				1						

The students were evaluated directly on these Student Outcomes through questions that were designed to measure performance on them. The scores on these Student Outcomes in the last two academic years are shown in Figure 4-1.

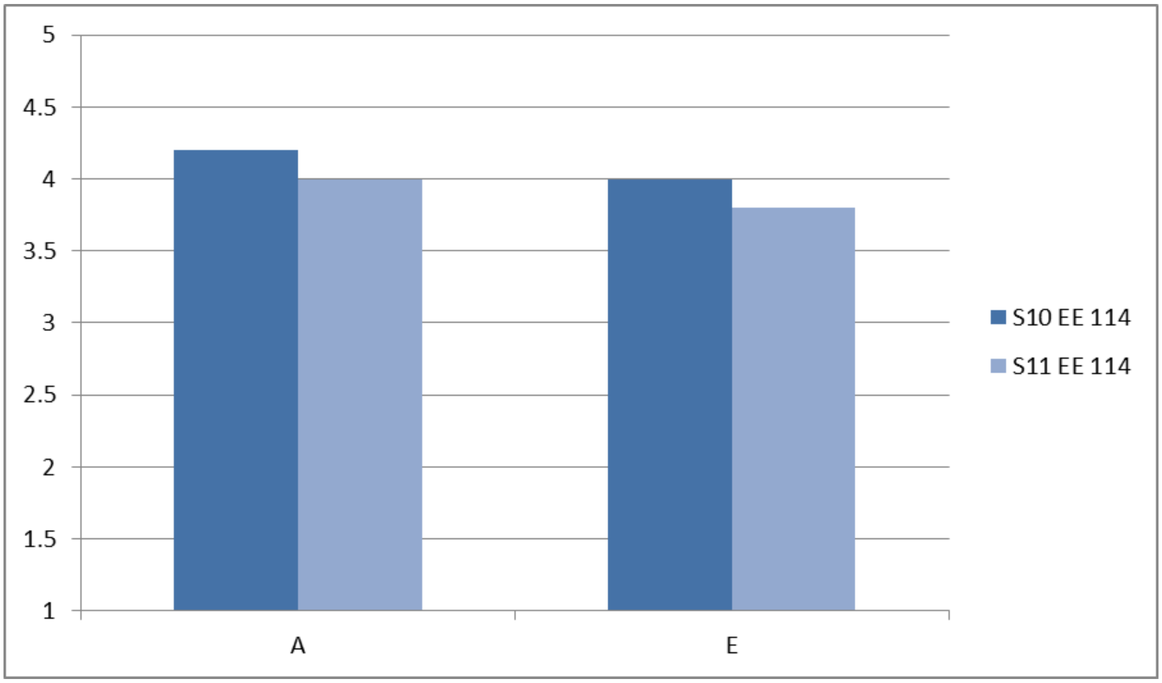


Figure 4-1. An example of results of measuring Student Outcome attainment (in this case, Student Outcomes A and E) in two courses.

At the end of each course, the students are also asked to complete a short survey on how well they believe the Student Outcomes were covered. The students are also asked to provide detailed comments on the strengths and deficiencies in the course. This provided a subjective perspective from the point-of-view of the student.

Below we provide an example of how the Student Outcomes were measured in EE175A/B (Senior Design Project) in the 2010-2011 academic year. The Course Matrix, mapping the Course Objectives to the Student Outcomes is available in Section 5.5.

An example for measuring the Student Outcomes.

We consider an example of how the Student Outcomes were measured in EE175 (Senior Design Project). A detailed description of the course is given in Section 5.5. The following were the set of questions used to measure performance on each Student Outcome. Also provided are summaries of some examples of the responses.

Example Response on Student Outcome b:

A team working on micromouse formulated their design specification to meet the requirements of the micromouse competition. The students chose the proper microcontroller, motors, drive circuits, used software tools to develop the control algorithm. In their design process, their experiments showed the infrared sensors on the market did not have a unique reading-distance relationship, in addition to being too bulky for their project. So they researched the principle of infrared sensing, and came up with two designs both of which were much simpler than the commercial sensors. After multiple experiments and analyses, they picked one of their designs and made their own infrared distance sensor which is an order of magnitude cheaper and only uses a very small number of components and provided a unique reading-distance relationship. Their micro mouse won awards at multiple regional competitions.

Example Response on Student Outcome c:
A student team working on a battery-less computer mouse using magnets designed and conducted extensive experiments to identify the relationship between the readings from a 3-axis digital compass with the position and movement of permanent magnets. They analyzed the data and established a mapping that enabled them to build a prototype that demonstrated the feasibility of a battery-less computer mouse.

Example Response on Student Outcome j:

"This project revolved around the use of Zigbee as a communication tool. Zigbee is a relatively new protocol, having first been released by the Zigbee Alliance in 2004. The Bitcloud stack represents Atmel¹s implementation of Zigbee PRO, which along with the standard Zigbee protocol, was released in 2007. As of now, this represents the most current version of Zigbee on the market.

Zigbee has many benefits over other wireless protocols such as Bluetooth and Wi-Fi. Bluetooth and Wi-Fi represent alternatives to cable connections for devices which require a high amount of fidelity. While Zigbee lacks the high data rate that Bluetooth and Wi-Fi offer, it is more suited for smaller devices. Zigbee has the ability to turn on and transmit data within 10 clock-cycles. As well, it has the ability to send data across a much further range than Bluetooth.

Furthermore, Zigbee has been optimized to support mesh networking. Mesh networking allows a signal to bounce across intermediate nodes to a final destination node. This means that even if a line of sight communication fails, the signal can be routed through other nodes in order to reach its target. Based on the stack that implements the Zigbee protocol, different features are available, but Zigbee has a whole amounts to a very robust network offering.

Zigbee is an extremely utilitarian protocol, which is perfectly suited for sensor networks, as well as simple point to point communication. Because Zigbee is capable of transmitting messages on the order of multiple bytes very quickly, over a long distance, and with relatively little power, it has been suggested as the successor of IR remote controls. After visiting Atmel¹s website, one will discover that a host of different control applications are already being proffered as potential development ideas.

A host of other sensors have also been suggested for Zigbee use, and in some cases they have been put into production. For instance, in January 2010, CAN2GO employed Zigbee technology developed by Ember to help cut building automation installation labor by 40% [1]. Clearly a 40% reduction in labor is a substantial amount of savings. While the ability to provide better feedback into a control system is not a new concept, Zigbee is making these types of feedback cheaper to provide and at longer periods of time.

Prospects for new Zigbee uses have increased with advances in the availability of low cost, low power microcontrollers. Furthermore, microcontroller vendors have begun to offer wireless communication chipsets that are designed for integration with their controller lines. The availability of the ATMEGA128RFA1 represents a new kind microcontroller that the market has to offer. It falls within their single chip solutions for the IEEE 802.15.4 standard. Where previous offerings required the use of two separate chips to harness the 802.15.4 standard, the ATMEGA128RFA1are meant to be connected directly to an antenna. They were debuted as recently as the 2010 CES."

Performance on Student Outcomes in EE175.

Figure 4-2 shows the scores on some of the questions related to the different Student Outcomes in EE175 in 2010-2011 averaged across all students.Such performance measures were obtained for each Student Outcome (normalized between 0 and 1). These were combined with the results from the end-of-course surveys and the combined values are shown in Figure 4-3 for the last three academic years (equal weightage was given to both).

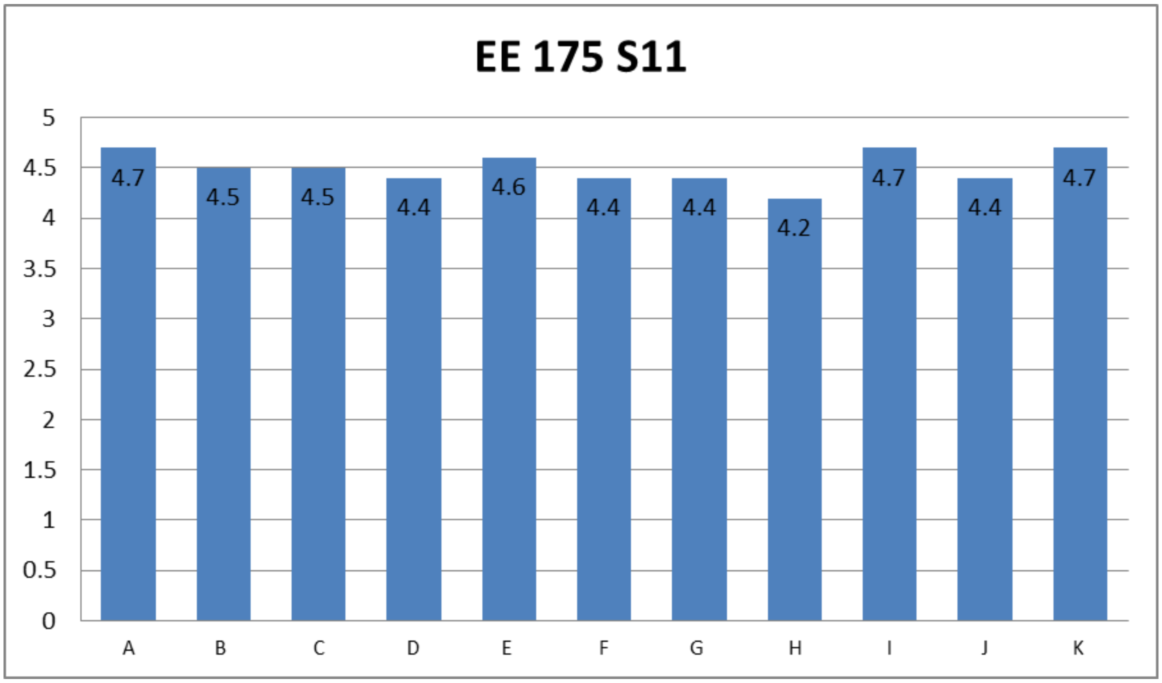


Figure 4-2. Scores on two example Student Outcomes in EE175 in 2010-11 academic year.

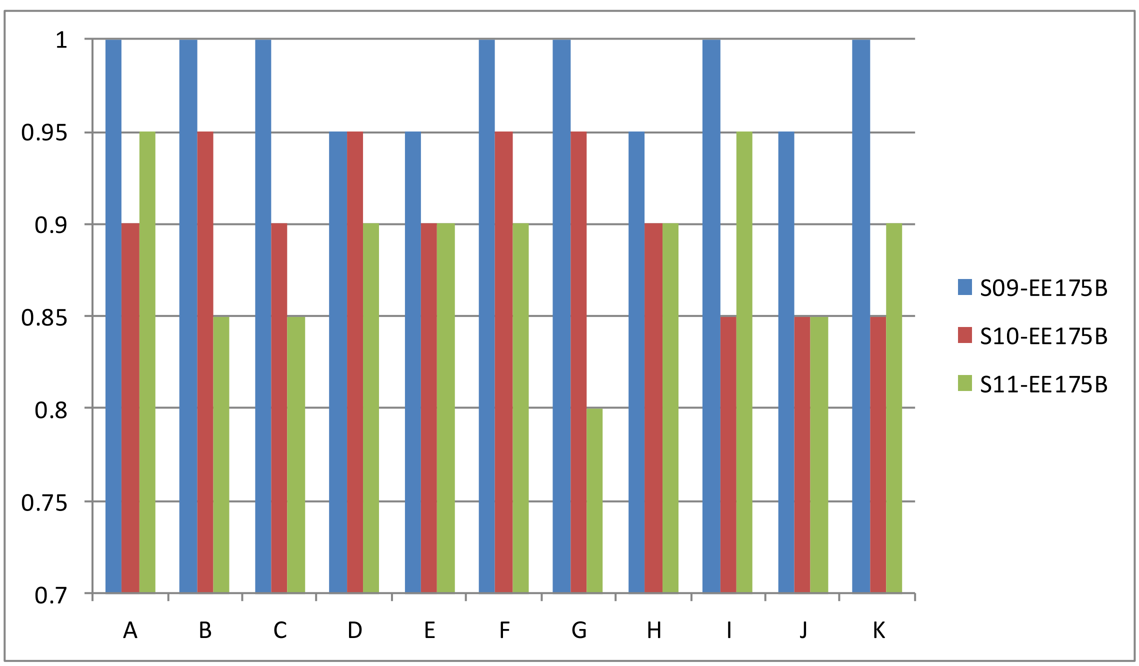


Figure 4-3. Analysis of all Student Outcomes in EE175 over the last three academic years.

Overall Analysis of Student Outcomes

The combination of direct evaluation of Student Outcomes through course instruments and end-of-course surveys, together with comments by students on teaching evaluations, student performance on tests and assignments, and informal discussions between an instructor and the students, provide an instructor and the entire faculty with information on how well a Student Outcome is covered in a course. The instructor summarizes his/her suggestions for possible changes in the course the next time it is offered in the Continuous Improvement form in the course folder. Changes such as the course textbook, homework or lab assignments are the prerogative of the instructor. If needed, the instructor can propose changes to the catalog description or EE curriculum, which need to be approved at various levels, as explained below. Numerous changes have been implemented based on this analysis and some examples are provided below under Continuous Improvement.

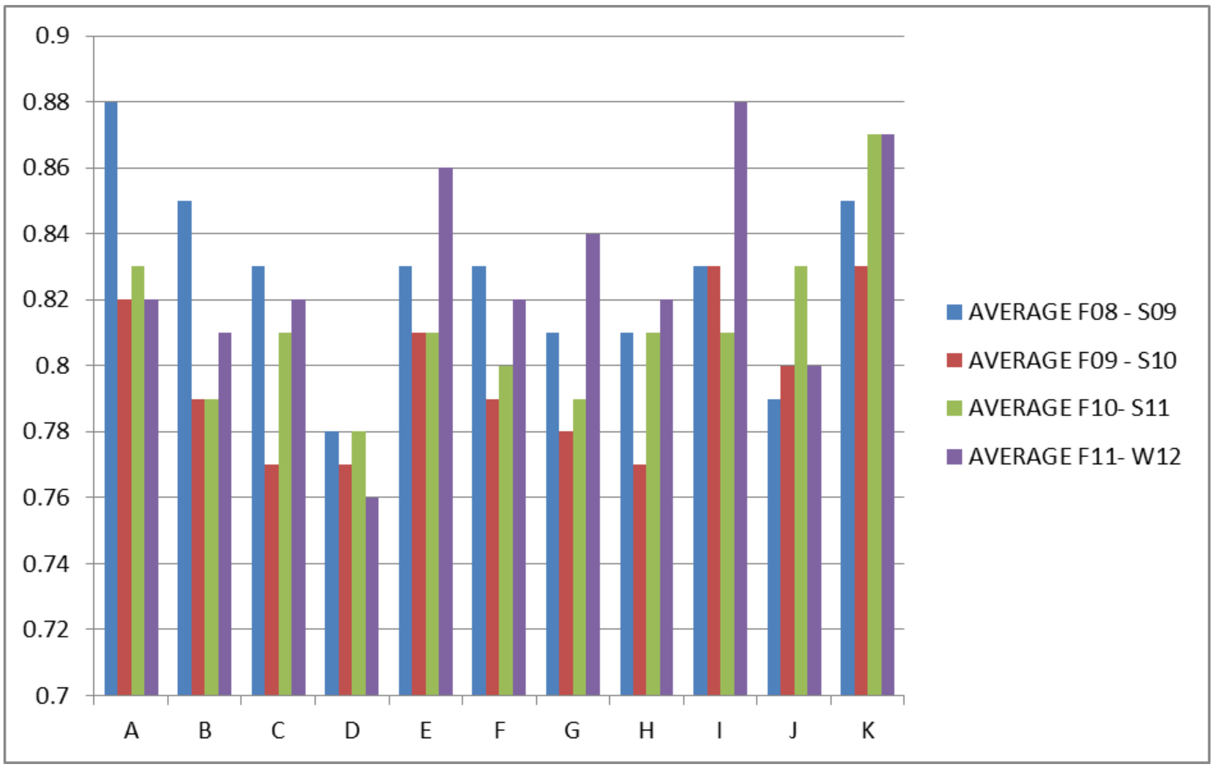


Figure 4-4. Analysis of Student Outcomes.

The ABET committee analyzes the results from the above two processes at a higher level to see how well the courses are meeting the Student Outcomes. This analysis is designed to reveal any issues in meeting the Student Outcomes over all the courses that the students take, rather than changes in individual courses. An analysis of the results is shown in Figure 4-4. The expectation is that faculty will make changes to the course so as to improve the measures of the Student Outcomes. **If the measure on any Student Outcome falls to below 0.7**, the Department Chair will work with the Undergraduate Committee and EE faculty to analyze what changes are necessary in the program to attain that Student Outcome better. The Student Outcomes are currently being met satisfactorily. A list of changes that have been implemented as part of the Continuous Improvement process is highlighted below.

The Senior Exit Surveys conducted before the students graduate also provide additional information about the achievement of the Student Outcomes and is considered in the process of the analysis. Figure 4-5 summarizes the results from 2011. Since the results are based purely on surveys and averaged over the entire curriculum, they are taken more as qualitative feedback on how the overall program is doing with respect to the Student Outcomes.

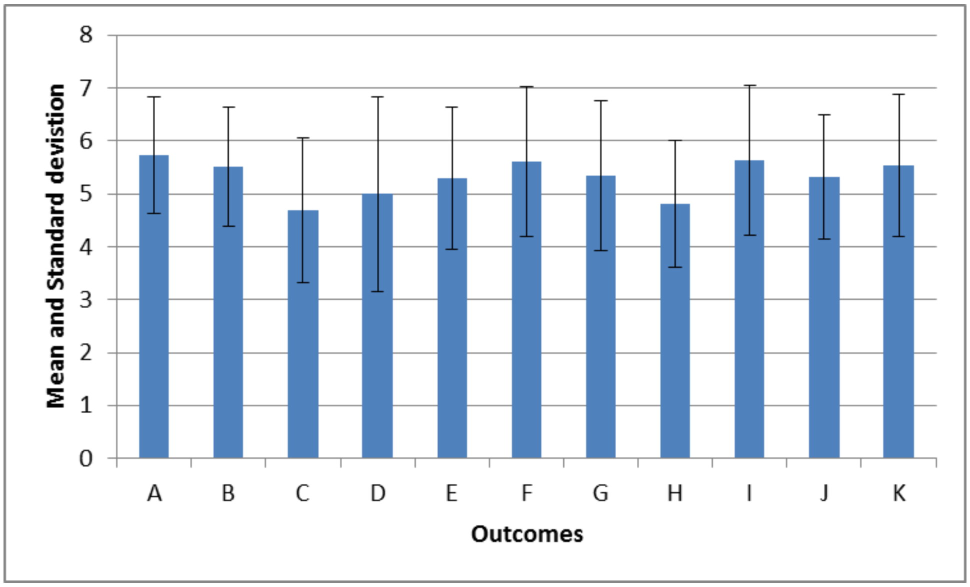


Figure 4-5. Summary of Senior Exit Survey Results in 2011.

4.3 Continuous Improvement

In addition to feedback from students, student affairs officers, faculty, alumni, and employers, the overall Continuous Improvement process incorporates the assessment results for both Program Educational Objectives (PEOs) and Student Outcomes (SOs). The continuous improvement cycle is shown in Figure 4-6.

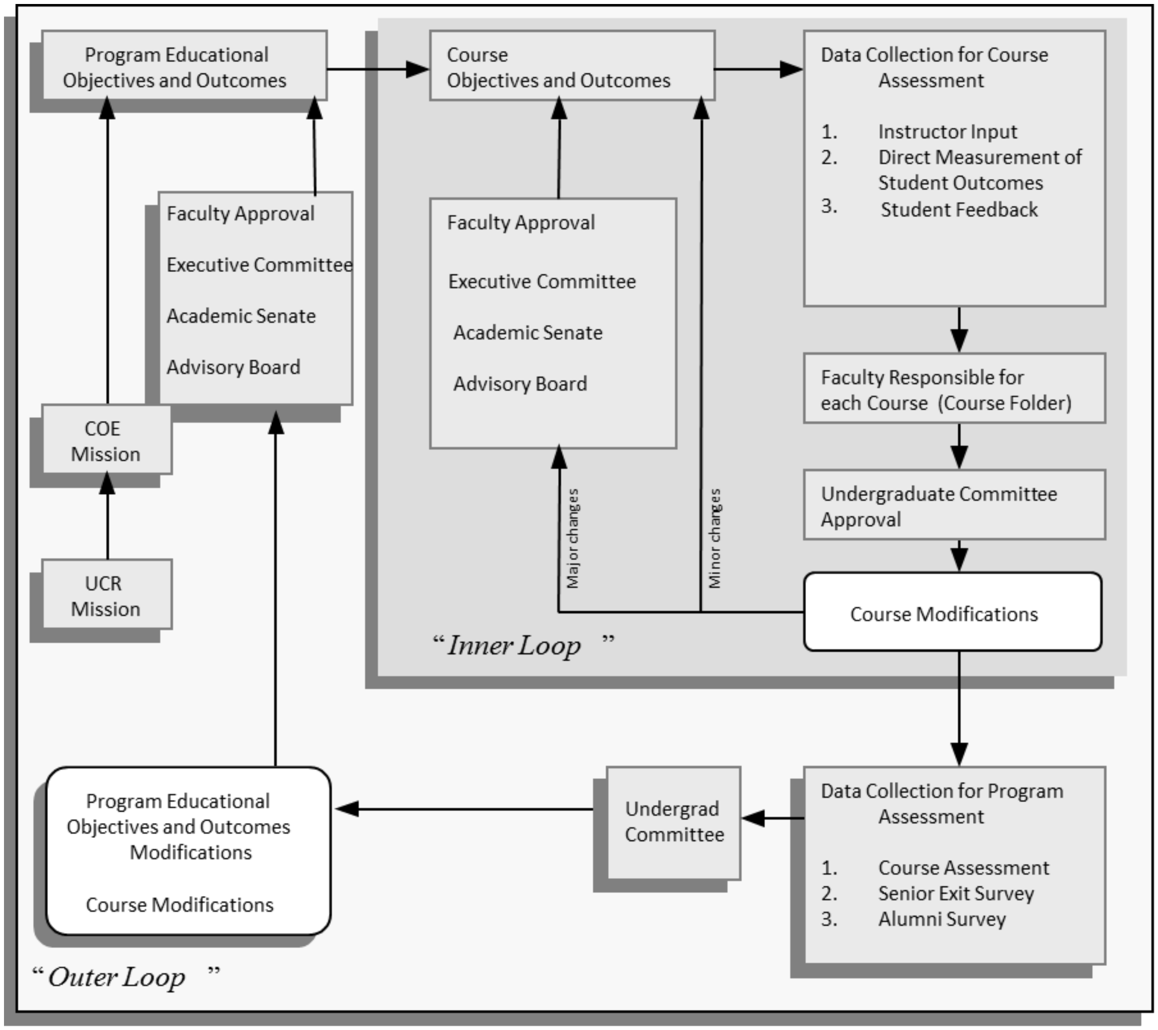


Figure 4-6. The continuous improvement cycle.

Based on the various forms of feedback, including evaluation of the PEOs and SOs, changes may need to be made to the elements of the program (e.g., courses) or the program structure. The Inner Loop depicts changes that affect the structure of individual courses only. The Outer Loop depicts program-level changes that may be affected by evaluation results on individual courses and surveys based on PEOs. Minor changes to the syllabus can be made directly by faculty. However, any changes that are reflected in the student catalog description or program-level changes need approval from the department faculty, college Executive Committee, and Academic Senate Committees. Figure 4-7 explains this process.

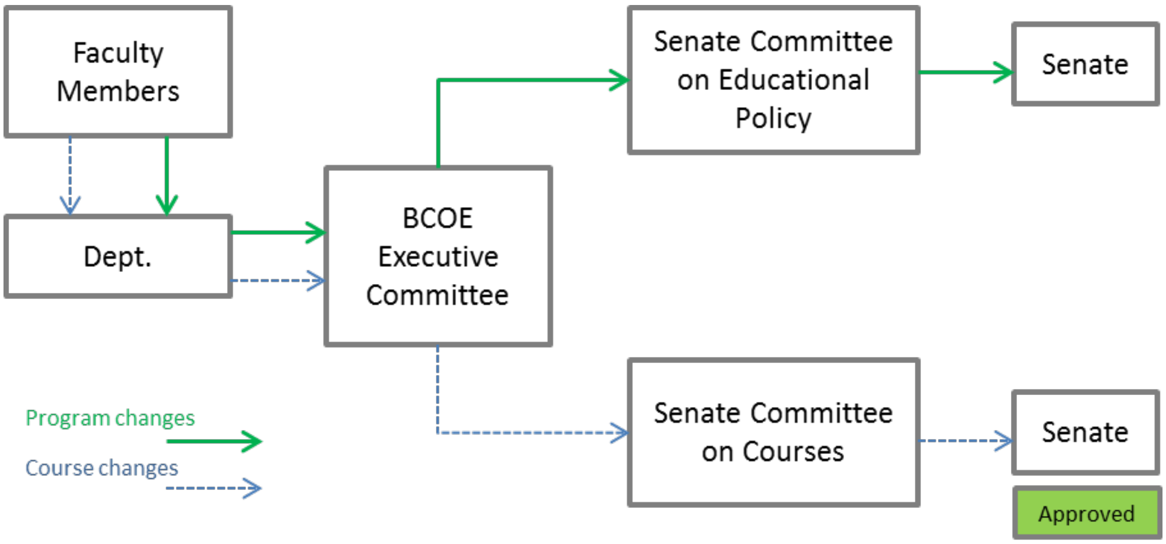


Figure 4-7. Process for catalog and program changes.

A number of changes have been made to the EE program based on the evaluation process for the PEOs, SOs, and other forms of feedback. Table 4-3 summarizes the major changes that have been implemented. The table states the observation that triggered the change, the action that was taken, and the result of the action. Sample meeting minutes are provided in Appendix E.

Table 4-3. Examples of major changes implemented in the EE Program.

Observation	Action	Result
Issue: The four year retention rate for incoming Freshmen was below 50%. **Source:** Analysis by the UG Committee and Dean's Office. While this is not atypical of STEM majors, the EE faculty wants to improve the UCR EE statistic.	A new course, EE10, was created. Its objectives were to create a sense of community between EE freshmen, to mentor them on the importance and difficulty of the first year courses, to educate them on aspects of the EE profession. It provided an overview of EE without increasing their workload. It was offered in Fall 2009 and 2010.	The students highly appreciated EE10. However, it did not seem to have a direct effect on retention and was discontinued in 2011. There is a plan to restart it with a new focus in Fall 2012. Details on the EE10 plans are provided below.
Issue: The four year retention rate for incoming Freshmen was below 50%. **Source:** Analysis by the UG Committee and Dean's Office. While this is not atypical of STEM majors, the EE faculty wants to improve the UCR EE statistic.	More EE and CS courses have been introduced in the first two years. These includes EE20 (Linear Methods) and CS10-13-61 (C++ Programming Introductory CS for Engineers-Machine Organization) in the freshman year and EE1AB (Circuit Analysis), EE120AB (Logic Design and Embedded Systems) and EE116 (Electromagnetics) in the sophomore year.	This change begins in Fall 2012. Therefore, there has not been any data collected yet to make a judgment about the effect on retention. However, the measure has been uniformly liked by our BOA and faculty. At its May 2012 meeting the BOA commended the EE faculty for their efforts to analyze and address the retention rates. It was also pointed out that the quality of the retained students should be measured.

		The issue of Retention is discussed below in further detail.
Issue: More exposure should be provided to energy related courses. **Source:** Faculty and BOA discussions.	Two courses in the area of power systems, namely EE123 (Power Electronics) and EE153 (Electric Drives) were introduced (Faculty Meeting Minutes 10-29-1010). Both the courses were approved at the campus level during 10/11.	EE123 is scheduled to be offered in 12/13. A new faculty (Hamed Mohseian-Rad) has been hired in this area.
Issue: The fact that students did not take BCOE courses early enough at UCR is considered to affect students' ties to BCOE and their understanding of the importance of math and science prerequisites to BCOE courses. **Source:** Informal discussions with faculty, students, BOA.	The sequence of courses that is recommended to students was modified to enable earlier incorporation of BCOE courses[3]. (Faculty Meeting Minutes 11-14-2011)	The recommended course sequence was distributed in 12/13. There is no data yet available to analyze the effects.
Issue: Students need better and earlier training in linear algebra, matrix methods for EE, and Matlab. **Source:** Various forms of feedback: students, faculty, UCR Committee on Educational Policy, course evaluations, assessment data (explained in Section 3) and the BOA	A new course, EE20, was introduced to cover linear algebra and matrix analysis and strengthen Matlab programming training. The following is the catalog description of EE20. (Faculty Meeting Minutes 11-14-2011) *Introduces MATLAB programming and linear methods for engineering analysis and design. Topics include formulating engineering problems as linear systems of equations; methods for finding their solutions; vector and matrix representations of signals and systems; matrix computations; and linear programming for system analysis and design.*	This course has been offered for two years. Many students in the upper division courses have not yet taken it. For example, in EE114 (Probability, Random Variables and Processes), less than one third of the class has taken this course. Therefore, it is still too early to judge the student performance. However, the change has received enthusiastic support from the faculty and BOA.

[3] Following are the current and revised plans for prerequisites.

		CURRENT				CHANGE	
QTR	FALL	WINTER	SPRING		FALL	WINTER	SPRING
FROSH		CSE 10	CSE 12		CSE 10 EE 10	CSE 12	CSE 61 EE 20
SOPH	CSE 61	EE 120A	EE 120B		EE 120A	EE 120B	EE 116

EE 128 was recommended for the junior year.

Issue: Students need repeated and sustained training in linear algebra, matrix methods for EE, and Matlab. **Source:** Various forms of feedback: students, faculty, UCR Committee on Educational Policy, course evaluations, assessment data, and the BOA	Given the existence of EE 20 in the freshmen year, the presentation of EE1A and 1B are being revised to fully incorporate linear algebra and matrix analysis methods.	This change will start in Fall 2012.
Issue: Lack of synchronization between lecture and lab topics. **Source:** Informal student feedback, course evaluations, assessment data, and the UCR CEP review.	The Chair reminded the faculty that although the TA's may run the lab sessions, it is the faculty's responsibility: i) to ensure lab manuals are updated and current. Lab manuals are now stored in the ABET folder in their editable (non-pdf) format to facilitate their maintenance, even following instructor changes. ii) to visit occasionally to observe lab sessions and ensure a high quality lab experience. iii) to synchronize labs to lecture to the extent possible. iv) to inform students of importance of completing pre-lab work before the lab. (Faculty Meeting Minutes 5-1-2009)	When this issue is noted in course evaluations, it will be addressed by the Chair with the relevant faculty.
Issues: Students complete Senior Design Project (EE175AB) close to the final week before graduation and are short of time need to write final report. In the previous two-quarter EE175AB structure in the Winter and Spring quarters, after students submit their final report in the finals week of Spring quarter, they left school and there is no time for the instructors to give back commented final reports to students for clarification, editing, revision, or improvement, which is an important step in design documentation. **Source:** Assessment data, Infor-	The Senior Design Project course has been changed from a two quarter sequence of EE175AB (4 units each) offered in the Winter and Spring of the senior year to a three-quarter sequence of EE175ABC (3 units, 4 unit and 1 unit respectively) offered in the Fall, Winter and Spring of the senior year. (Faculty Meeting Minutes 11-14-2011)	This change has just been approved by the Faculty and BCOE Executive Committee. It has the support of the BOA. It will be implemented from the 12/13 academic year. In the new three quarter structure, students are still required to complete the project in two quarters; at the end of the second quarter they make the final presentation and demo of the design. They complete and submit a draft final report in the third quarter. The instructor will review and mark up the final report with comments. The students address the instructor feedback on the draft report and sub-

mal discussion between students and faculty.		mit a revised report. In this format, the instructors will have sufficient time to comment on the final reports, send feedback and improvement requirements to students. Students will then complete the requirements and resubmit the final reports including any improvements of the design, which will be used for final grading. This completes the feedback loop.
Issue: Desire to better cover the course objectives of EE175A/B. **Source:** Informal discussion between faculty, assessment data.	The instructors have further updated the lectures and final report requirements. Highlights of the updates are that we introduced: • A lecture on Systems Engineering (based on NASA material) to introduce the concepts and practice of systems engineering • A lecture on data analysis techniques • A lecture on lab skills and an exam to gain 24-hour lab access • A career center counselor is invited to lecture on resume writing and job search • A short essay has been added as part of the final report on how working on the design project helps students recognize the need for and an ability to engage in lifelong learning • In addition to a lecture and exam on professional ethics, a short essay is required as part of the final report to discuss potential ethics consideration of the project and design process • To remind students to practice professional ethics and make ethics a more concrete and measurable requirement, new in 2012, we are introducing ethics evaluation by team members and instructors on professional responsibility, how well a student functions in the team, helping team members, being dependable and honest, etc. The	These changes are introduced this year and there is no data available yet.

	Senior Design Project syllabus with the ethics evaluation form is attached. • More detailed instructions are given in the final report template on realistic constraints and industry standards to guide the students in their design considerations.	
Issue: Desire to improve students' technical writing skills **Source:** Discussions by faculty in EE and other BCOE departments, assessment by associate dean and student affairs office, discussions with students, assessment data	ENGR 180W was introduced in 2010 to satisfy improved writing and communication skills. ENGL 1C was dropped from the requirements.	Samples of students work in ENGR 180W, annotated by the student outcomes, are examined by the EE ABET chair, and the performance is discussed at faculty meetings. This course was designed to have a heavy loading on outcomes f, g, h, i and j, and its introduction does coincide (with an appropriate time lag) with improvements in these SOs as measured in EE 175 (although it is difficult to establish causality)

4.3.1 EE10

The revised EE010 course has a variety of programmatic objectives: start the faculty-student interaction right from the beginning, introducing students to the EE profession and the UCR EE program, and advising on how to succeed at UCR. An underlying objective is to provide the engineering application background and help students understand why the mathematical and scientific topics that they will be learning in their freshman and sophomore years will be important to their upper division courses and to their career in the future, so that hopefully, they will be motivated to work hard in the math and basic science courses to be better prepared for success in the EE program. One means to achieve this objective will be to invite recent alumni, within 5 years of graduation, to give guest lectures within the class. The main topic of their presentation will be how they are using the skills acquired from the EE program in their jobs, through examples of their recent projects. We will also request that they discuss which mathematical and scientific principles they found most useful in their projects and careers. Faculty at the lecture will help the students and alumni to map these principles back to specific courses within the EE curriculum. The faculty organizing the course will try to select alumni to do this well.

4.3.2 Retention

To improve retention rates, the Electrical Engineering program has made the following changes. New first year courses have been introduced (EE 10 and 20) and appropriate BCOE courses have been moved to the first two years. These include CS10-13-61 (C++ Programming-Introductory CS for Engineers-Machine Organization) in the freshman year and EE1AB (Circuit Analysis), EE120AB (Logic Design and Embedded Systems) and EE116 (Electromagnetics) in the sophomore year.

EE10 was offered in Fall 2009 and Fall 2010. That instantiation of EE 10 was created with the sole purpose of increasing the retention rate of our incoming freshmen since the retention rate was often (and still is) below 50%. The objectives were to introduce the EE profession and to create some feeling of "belonging" in the freshman year, since previously, EE majors did not take any EE courses until late in their sophomore year. The goal was to give the freshmen an overview of EE without increasing their workload. However, there was no immediate impact on overall retention statistics and was discontinued in Fall 2011. The plan is to restart the course in Fall 2012 with the new course structure described in Section 4.3.1.

4.4 Additional Information

Course folders providing details on the ABET process will be made available electronically at the time of the review. This can also be made available to the reviewer electronically. The reviewer should contact the people listed on the first page to get the login information. Faculty meeting minutes are included in Appendix E.

CRITERION 5. CURRICULUM

5.1 Curriculum over the Past Two Years

Table 5-1 on the following page describes the courses that have been offered over the past two years. Figure 5-1 (a-b) is a facsimile of the recommended course of study leading to the bachelor's degree in electrical engineering. The recommended course of study is updated annually and is available through the student affairs office and on the web: Course of Study.

UCR | Bourns College of Engineering

Suggested Course Plan for a UC Riverside Major in

ELECTRICAL ENGINEERING

Catalog Year: 2012

Fall Quarter	*Units*	*Winter Quarter*	*Units*	*Spring Quarter*	*Units*
		FIRST YEAR			
CS 010 *C++ Programming I*	4	CS 013 *Introduction to CS for Engineers*	4	CS 061 *Machine Org. & Assembly Lang. Prog.*	4
EE 010 *Intro to Electrical Engineering*	2	ENGL 001B *Intermediate Composition*	4	EE 020 *Linear Methodsfor Engr. Analysis*	4
ENGL 001A *Beginning Composition*	4	MATH 009B *First Year Calculus*	4	MATH 009C *First Year Calculus*	4
MATH 009A *First Year Calculus*	4	PHYS 040A *Physics (Mechanics)*	5	PHYS 040B *Physics (Heat/Waves/Sound)*	5
		SECOND YEAR			
EE 001A & EE 01LA *Engineering Circuit Analysis I & Lab*	4	EE 001B *Engineering Circuit Analysis II*	4	CS/EE 120B *Embedded Systems*	5
MATH 046 *Differential Equations*	4	EE/CS 120A *Logic Design*	5	EE 116 *Engineering Electromagnetics*	4
PHYS 040C *Physics (Electricity/Magnetism)*	5	MATH 010A *Multivariable Calculus*	4	MATH 010B *Multivariable Calculus*	4
CHEM 001A & CHEM 01LA *General Chemistry and Lab*	5	Breadth _________ *Humanities/Social Sciences*	4	Breadth _________ *Humanities/Social Sciences*	4
		THIRD YEAR			
EE 100A *Electronic Circuits*	4	EE 100B *Electronic Circuits*	4	EE 114 *Prob., Random Variables & Processes*	4
EE 110A *Signals & Systems*	4	EE 105 *Model. & Simulation of Dynamic Sys.*	4	EE 132 *Automatic Control*	4
ENGR 180W* *Technical Communications*	4	EE 110B *Signals & Systems*	4	Breadth _________ *Humanities/Social Sciences*	4
Technical Elective** *EE 128 Recommended*	4	Biol. Sci. Major Requirement *BIOL 002, 003 or 005A/05LA*	4	Breadth _________ *Humanities/Social Sciences*	4
		FOURTH YEAR			
EE 115 *Intro to Communications*	4	EE 175B *Senior Design Project*	4	EE 175C *Senior Design Project*	1
EE 141 *Digital Signal Processing*	4	Technical Elective** _______________	4	Technical Elective** _______________	4
EE 175A *Senior Design Project*	3	Technical Elective** _______________	4	Technical Elective** _______________	4
Breadth _________ *Humanities/Social Sciences*	4			Breadth _________ *Humanities/Natural Sciences*	4

Total Units: 188

Maximum Units: 225

To earn a B.S., you must complete all College and University requirements. For a complete list: www.catalog.ucr.edu.

ENGLISH COMPOSITION*

A C or better is required in three quarters of English Composition courses to satisfy the graduation requirement. ENGR 180W fulfills the third quarter of English Composition.

BREADTH REQUIREMENTS

For an approved list of Breadth courses: http://student.engr.ucr.edu/policies/requirements/breadth.html.

Humanities: (3 courses)
- A. World History: _________
- B. Fine Arts, Lit., Phil. or Rlst: _________
- C. Human Persp. on Science: _________

Social Sciences: (3 courses)
- A. Econ. or Posc.: _________
- B. Anth., Psyc, or Soc.: _________
- C. General Social Science: _________

Ethnicity: (1 course)
1. ____________

Upper Division Depth: (2 courses)
1. ____________
2. ____________

TECHNICAL ELECTIVES **

Please note that Technical Electives may be offered throughout the Academic Year. Consult with your Academic Advisor about potential offerings. See approved technical electives on back.

Course Plan is subject to change.

Figure 5-1(a). The recommended course plan for a bachelor's degree in electrical engineering.

Electrical Engineering Technical Electives and Focus Areas

You must complete 5 courses (at least 20 units) of Technical Elective coursework chosen from the list below. It is recommended that at least 3 courses are chosen from one Focus Area. Courses marked with * are required course for a focus area. Units are listed in ().

Intelligent Systems (IS)

***EE 146**	*Computer Vision (4)*
EE 128	Data Acquistion, Instrum., & Process Control (4)
EE 140	Computer Visualization (4)
EE 144	Introduction to Robotics (4)
EE 152	Image Processing (4)
CS 122A	Intermediate Embedded and Real-time Systems (5)
CS 130	Computer Graphics (4)

Nanotechnology, Advanced Materials, and Devices (NMDC)

**EE 133*	*Solid-State Electronics (4)*
EE 117	Electromagnetics II (4)
EE 134	Digital Integrated Circuit Layout and Design (4)
EE 135	Analog Integrated Circuit Layout and Design (4)
EE 136	Semiconductor Device Processing (4)
EE 137	Intro to Semiconductor Optoelectronic Devices (4)
EE 138	Electronic Properties of Materials (4)
EE 139	Magnetic Materials (4)
EE 160	Fiber Optic Communication Systems (4)

Communications, Signal Processing and Networking (CSP)

**EE 150*	*Digital Communications (4)*
EE 117	Electromagnetics II (4)
EE 128	Data Acquistion, Instrum., & Process Control (4)
EE 152	Image Processing (4)
EE 160	Fiber Optic Communication Systems (4)
CS 122A	Intermediate Embedded and Real-time Systems (5)
CS 161	Design and Architecture of Computer Systems (4)

Control and Robotics (CR)

**EE 151*	*Introduction to Digital Control (4)*
EE 128	Data Acquistion, Instrum., & Process Control (4)
EE 144	Introduction to Robotics (4)
EE 146	Computer Vision (4)
EE 152	Image Processing (4)
CS 122A	Intermediate Embedded and Real-time Systems (5)

VLSI Design and Systems (VLSI)

** EE 134*	*Digital Integrated Circuit Layout and Design (4)*
EE 128	Data Acquistion, Instrum., & Process Control (4)
EE 133	Solid-State Electronics (4)
EE 135	Analog Integrated Circuit Layout and Design (4)
EE 136	Semiconductor Device Processing (4)
CS 161	Design and Architecture of Computer Systems (4)
CS 168	Introduction to VLSI Design (5)

Computer Engineering (CE)

* Refer to the Computer Engineering major course plan and catalog listing

*Required course for the Focus Area

Figure 5-1(b). The list of technical electives based on each specialization.

Table 5-1. Curriculum, F2010-S2012.

ELECTRICAL ENGINEERING COURSES		Indicate Whether Course is Required, Elective or a Selected Elective (R, E, SE)	Subject Area (Credit History)				Last Two Terms the Course was Offered:	Maximum Course Enrollment for Last Two Terms Course was Offered:
Department and Course Number	Title		Math & Basic Sciences	Engineering Topics (if contains signif. Design)	General Education	Other		
FALL QUARTER, YEAR 1								
ENGL 001A	Beginning Composition	R			4		S2012, W2012	272, 918
MATH009A	First-Year Calculus	R	4				S2012, W2012	110, 276
EE 10 Breadth ___________	Intro to EE	R		2	4			
WINTER QUARTER, YEAR 1								
CS 010	C++ Programming	R	4				S2012, W2012	210, 239
ENGL 001B	Intermediate Composition	R			4		S2012, W2012	1205, 1715
MATH 009B	First-Year Calculus	R	4				S2012, W2012	567, 847
PHYS 040A	General Physics	R	4				W2012, F2011	354, 283
SPRING QUARTER, YEAR 1								
CS 013	Introduction to CS for Engineers	R	4				S2012, S2011	67, 50
EE 020	Linear Methods for Engineering Analysis	R	4				S2012, S2011	90, 83
MATH 009C	First-Year Calculus	R	4				S2012, W2012	417, 407
PHYS 040B	General Physics	R	5				S2012, W2012	281, 261
FALL QUARTER, YEAR 2								
CS 061	Machine Organization & Assembly Language Programming	R		4(X)			S2012, W2012	90, 88
EE 001A & EE 01LA	Engineering Circuit Analysis I and Lab	R		4			S2012, F2011	230, 175
MATH 046	Differential Equations	R	4				S2012, W2012	278, 273
PHYS 040C	General Physics	R	5				S2012, F2011	285, 289

WINTER QUARTER, YEAR 2								
EE 001B	Engineering Circuit Analysis II and Lab	R		4			W2012, F2011	87, 27
EE/CS 120A	Logic Design	R		5(X)			W2012, F2011	60, 60
MATH 010A	Multivariable Calculus	R	4				S2012, W2012	277, 331
Breadth __________		R			4			
SPRING QUARTER, YEAR 2								
CS/EE 120B	Embedded Systems	R		5(X)			S2012, W2012	58, 67
MATH 010B	Multivariable Calculus	R	4				S2012, W2012	225, 195
Breadth __________		R			4			
FALL QUARTER, YEAR 3								
CHEM 001A/LA	General Chemistry	R	5				W2012, F2011	539, 1140
EE 100A	Electronic Circuits	R		4(X)			W2012, F2011	32, 47
EE 110A	Signals and Systems	R		4			W2012, F2011	34, 52
ENGR 180W	Technical Communications	R		4			S2012, F2011	72, 48
WINTER QUARTER, YEAR 3								
EE 100B	Electronic Circuits	R		4(X)			S2012, W2012	20, 46
EE 105	Modeling and Simulation of Dynamic Systems	R		4			W2012, W2011	58, 41
EE 110B	Signals and Systems	R		4			S2012, W2012	37, 46
Breadth __________	Biological Sciences	R	5					
SPRING QUARTER, YEAR 3								
EE 114	Probability, Random Variables & Processes	R		4			S2012, S2011	40, 45
EE 116	Engineering Electromagnetics	R		4			S2012, S2011	56, 25
EE 132	Automatic Control	R		4(X)			S2012, S2011	42, 41
Breadth __________		R			4			
FALL QUARTR, YEAR 4								
EE 115	Introduction to Communication Systems	R		4			F2011, F2010	38, 32

EE 141	Digital Signal Processing	R		4(X)			F2011, F2010	40, 34
Technical Elective**		R		4(X)				
Technical Elective**		R		4(X)				
WINTER QUARTER, YEAR 4								
EE 175A	Senior Design Project	R		4(X)			W2012, W2011	44, 27
Technical Elective**		R		4(X)				
Technical Elective**		R		4(X)				
Breadth __________		R			4			
SPRING QUARTER, YEAR 4								
EE 175B	Senior Design Project	R		4(X)			S2012, S2011	43, 27
Technical Elective**		R		4(X)				
Breadth __________		R			4			
TECHNICAL ELECTIVES AND FOCUS AREAS								
INTELLIGENT SYSTEMS (IS)								
EE 128	Data Acquisition, Instrum., & Process Control	SE					F2011, F2010	28, 29
EE 146	Computer Vision	SE					W2012, W2010	34, 20
EE 140	Computer Visualization	SE					F2009, S2007	19, 3
EE 144	Introduction to Robotics	SE					S2012, S2011	18, 22
EE 152	Image Processing	SE					W2009, W2008	18, 34
CS 122A	Intermediate Embedded & Real-Time Systems	SE					F2011, F2010	30, 44
CS 130	Computer Graphics	SE					S2012, W2011	32, 30
NANOTECHNOLOGY, ADVANCED MATERIALS, and DEVICES (NMDC)								
EE 133	Solid-State Electronics	SE					F2011, F2010	23, 26
EE 117	Electromagnetics II	SE					W2010, W2009	8, 9
EE 134	Digital Integrated Circuit Layout and Design	SE					W2012, W2011	10, 5
EE 135	Analog integrated Circuit Layout and Design	SE					S2012, S2011	11, 6

EE 136	Semiconductor Device Processing	SE					S2012, S2011	10, 7
EE 137	Intro to Semiconductor Optoelectronic Devices	SE					W2012, W2011	13, 12
EE 138	Electronic Properties of Materials	SE					F2011, F2010	28, 14
EE 139	Magnetic Materials	SE					W2012, W2011	36, 29
EE 160	Fiber Optic Communication Systems	SE					F2010, F2009	5, 4
COMMUNICATIONS, SIGNAL PROCESSING, and NETWORKING (CSP)								
EE 150	Digital Communication	SE					W2012, W2011	18, 14
EE 117	Electromagnetics II	SE					W2010, W2009	8, 9
EE 128	Data Acquisition, Instrum., & Process Control	SE					F2011, F2010	28, 29
EE 152	Image Processing	SE					W2009, W2008	18, 34
EE 160	Fiber Optic Communication Systems	SE					F2010, F2009	5, 4
CS 122A	Intermediate Embedded & Real-Time Systems	SE					F2011, F2010	30, 44
CS 161	Design and Architecture of Computer Systems	SE					S2012, F2011	37, 29
CONTROL and ROBOTICS								
EE 151	Introduction to Digital Control	SE					S2012, S2011	22, 13
EE 128	Data Acquisition, Instrum., & Process Control	SE					F2011, F2010	28, 29
EE 144	Introduction to Robotics	SE					S2012, S2011	18, 22
EE 146	Computer Vision	SE					W2012, W2010	34, 20
EE 152	Image Processing	SE					W2009, W2008	18, 34
CS 122A	Intermediate Embedded & Real-Time Systems	SE					F2011, F2010	30, 44
VLSI DESIGN and SYSTEMS (VLSI)								
EE 134	Digital Integrated Circuit Layout and Design	SE					W2012, W2011	10, 5
EE 128	Data Acquisition, Instrum., & Process Control	SE					F2011, F2010	28, 29
EE 133	Solid-State Electronics	SE					F2011,	23, 26

							F2010	
EE 135	Analog integrated Circuit Layout and Design	SE					S2012, S2011	11, 6
EE 136	Semiconductor Device Processing	SE					S2012, S2011	10, 7
CS 161	Design and Architecture of Computer Systems	SE					S2012, F2011	37, 29
CS 168	Introduction to VLSI Design	SE					W2004, W2003	6, 19
TOTALS-ABET BASIC-LEVEL REQUIREMENTS								
OVERALL CREDIT HOURS FOR COMPLETION OF THE PROGRAM		188	60	96	32			
PERCENT OF TOTAL			32%	51%	17%			
Total must satisfy either credit hours or percentage	Minimum Quarter Credit Hours		47 hours	70.5 hours				
	Minimum Percentage		25%	37.50%				

5.2 Alignment with the Program Educational Objectives

The PEOs state our three main objectives: enable our graduates to pursue higher degrees, be successful in their industrial positions, and be good citizens of the community. The courses are structured to ensure that our graduates have all the required skills to meet these objectives.

- Table 3-1 shows how the Student Outcomes align with the PEOs.
- Table 4-1 shows how the EE courses align with the Student Outcomes.
- Table 5-1 shows the EE courses offerings, which are designed to ensure that students can get the EE courses in the order necessary to satisfy the suggested course sequence, along with some degree of flexibility. As is evident from Table 5-1 our students get a broad training in various aspects of EE that provide the technical foundations for both higher studies and industrial positions requiring such technical skills. These courses include and build on the basic science and math courses, the core EE courses, computer programming expertise, technical electives covering all the areas of the department, and a comprehensive senior design project.
- Students are also required to take technical communication and writing courses (Engl 1A, Engl 1B, and ENGR 180W) that are essential for success.
- We also prepare our students to be mindful of their ethical responsibilities and the broader role of engineering in society. These are covered in a number of courses, but most thoroughly in the Senior Design Project.
- The UCR General Education requirements provide a general and non-technical educational perspective as necessary to understand and contribute to societal well-being.

5.3 Prerequisite Structure

Table 4-1 in Criterion 4 provides an overview of how our curriculum attains all the student outcomes. The program design ensures that each outcome is covered in at least one of the required courses (most outcomes are covered in multiple courses), thus ensuring that the outcomes are attained by every student.

Table 5-2 illustrates the prerequisite structure of the required courses for electrical engineering. The prerequisites ensure that students enrolling in each course have the knowledge expected to ensure their success in that course. This combined with the specified course sequence and the information in Table 4.1 ensures the attainment of the Student Outcomes by all students.

Table 5-2. Prerequisite Chart

		CHEM 1HA	CS 010	CS 012	CS 013	CS 061	CS 100	CS 120A/EE 120A	CS 120B/EE120B	CS 141	CS 161L	MATH 005	MATH 008A	MATH 008B	MATH 009A	MATH 009B	MATH 009C	MATH 09HA	MATH 09HB	MATH 09HC	MATH 010A	MATH 113	MATH 046	ME 103	PHYS 040A	PHYS 040B	PHYS 040C	EE 001A	EE 001B	EE 100A	EE 100B	EE 105	EE 110A	EE 110B	EE 114	EE 115	EE 116	ENGR 118	EE 132	EE 133	EE 134	EE 141	EE 175A	ENGR 180W	ENGL 001B
Math and Science 74 Units	BIO																																												
	CHEM 1A											X																																	
	CHEM 1LA	X																																											
	CS 010														X																														
	CS 013		X																																										
	CS 061								X																																				
	MATH 008B												X																																
	MATH 009A											X																																	
	MATH 009B													X	X				X																										
	MATH 009C															X			X																										
	MATH 010A															X			X																										
	MATH 010B																				X																								
	MATH 046															X			X																										
	PHYS 040A													X	X	X		X	X																										
	PHYS 040B																X			X					X																				
	PHYS 040C																X			X						X																			
Core Courses 62 Units	EE 100A																												X																
	EE 100B																													X															
	EE 105		X																				X					X																	
	EE 110A		X																				X						X																
	EE 110B																																X												
	EE 114																																X												
	EE 115																																	X											
	EE 116																												X																
	EE 132																							X								X	X					X							
	EE 141																																	X											
	EE 175A																																											X	
	EE 175B																																										X		
	EE 120A					X																																							
	EE 120B							X																																					
	ENGR 180W																																												X
Elective Courses 20 Units	CS 122A			X	X				X																																				
	CS 130						X			X												X																							
	EE 143		X																																										
	CS 161								X		X																																		
	CS 168							X																																					
	EE 117																																				X								
	EE 128							X																							X														
	EE 133																													X	X														
	EE 134							X																				X	X	X										X					
	EE 135																											X	X	X	X									X	X				
	EE 136																																							X					
	EE 137																																							X					
	EE 138																										X																		
	EE 139																										X																		
	EE 140																																												
	EE 144																																						X						
	EE 146																																												
	EE 150																																		X	X									
	EE 151																																						X			X			
	EE 152																																	X											
	EE 160																																			X	X								

5.4 Hours and Depth of Study

The graduation requirements have been provided in Criterion 1. They include 59 units of Breadth Requirements, 60 Units of Basic Math and Science, 76 Units of Core courses, and 20 units of electives. The graduation requirements call for 74 lower division and 82 upper division units. These correspond to 60 math and basic sciences units and 96 engineering units. The courses that make up each of these categories are shown in Table 5-3.

Table 5-3. Courses for Graduation Requirement. (a) Breadth and math/science requirements. (b) Core and elective Electrical Engineering courses.

BREADTH REQUIREMENTS	UNITS
ENGL 001A	4
ENGL 001B	4
ENGR180W (ENGL001C Alternate)	4
HUMANITIES 1: One course in World History	4
HUMANITIES 2: One course in the area of Fine Arts or Literature or Philosophy or Religious Studies	4
HUMANITIES 3: One additional course chosen from History, Fine Arts, Literature, Philosophy, Religious Studies; a foreign language at level 3 or above; Humanities courses offered by Ethnic Studies, Creative Writing, Humanities and Social Sciences, Latin American Studies, Linguistics, or Women's Studies	4
SOCIAL SCIENCE 1: One course in Economics or Political Science	4
SOCIAL SCIENCE 2: One course in Anthropology, Psychology, or Sociology	4
SOCIAL SCIENCE 3: One additional social science course in Ethnic Studies, Geography, Human Development, or Women's Studies, or one of the disciplines in SS1 or SS2.	4
***BIOLOGICAL SCIENCES**	4
***General Chemistry** (CHEM 001A)	4
***General Chemistry Laboratory** (CHEM 01LA)	1
***First Year Calculus** MATH 009A	4
***General Physics** (PHYS 040A)	5
***General Physics** (PHYS 040B)	5
BREADTH REQUIREMENTS TOTAL UNITS (Includes English Composition)	**59**

MATH/SCIENCES	UNITS
BIOLOGICAL SCIENCES	5
General Chemistry (CHEM 001A)	4
General Chemistry Laboratory (CHEM 01LA)	1
Intro to Computer Science for Science, Mathematics, and Engineering (CS 010)	4
Intro to Computer Science for Engineering Majors (CS 013)	4
Linear Methods for Engineering Analysis (EE 020)	4
First Year Calculus (MATH 009A)	4
First Year Calculus MATH 009B	4
First Year Calculus MATH 009C	4
Calculus of Several Variables (MATH 010A)	4
Calculus of Several Variables MATH 010B	4
Intro to Ordinary Differential Equations (MATH 046)	4
General Physics (PHYS 040A)	4
General Physics PHYS 040B	5
General Physics PHYS 040C	5
BASIC MATH/SCIENCE TOTAL UNITS	**60**

CORE	UNITS
Intro to Electrical Engineering (EE 010)	2
Engineering Circuit Analysis I (EE 001A)	3
Engineering Circuit Analysis I Lab (EE 01LA)	1
Engineering Circuit Analysis II (EE 001B)	4
Machine Organization and Assembly Language Programming (CS 061)	4
Electronic Circuits (EE 100A)	4
Electronic Circuits (EE 100B)	4
Modeling and Simulation of Dynamic Systems (EE 105)	4
Signal and Systems (EE 110A)	4
Signal and Systems (EE 110B)	4
Probability, Random Variables, and Random Processes in Electrical Engineering (EE 114)	4
Intro to Communication Systems (EE 115)	4
Engineering Electromagnetics (EE 116)	4
Logic Design (EE 120A/CS 120A)	5
Intro to Embedded Systems (EE 120B/CS 120B)	5
Automatic Control (EE 132)	4
Digital Signal Processing (EE 141)	4
Senior Design Project (EE 175A)	4
Senior Design Project	4

ELECTIVES	UNITS
Intermediate Embedded and Real-Time (CS 122A)	5
Computer Graphics (CS 130)	4
Design and Architecture of Computer Systems (CS 161)	4
Intro to Very Large Scale Integration Design (EE/CS 168)	5
Electromagnetics II (EE 117)	4
Power Electronics (EE 123)	4
Data Acquisition, instrumentation, and Process (EE 128)	4
Solid-State Electronics (EE 133)	4
Digital Integrated Circuit Layout and Design (EE 134)	4
Analog Integrated Circuit Layout and Design (EE 135)	4
Semiconductor Device Processing (EE 136)	4
Intro to Semiconductor Optoelectronic Devices (EE 137)	4
Electrical Properties of Materials (EE 138)	4
Magnetic Materials (EE 139)	4
Computer Visualization (EE 140)	4
Intro to Robotics (EE 144)	4
Computer Vision (EE 146)	4
Digital Communications (EE 150)	4

(EE 175B)	
Technical Communications (ENGR180W)	4
CORE COURSES TOTAL UNITS	**76**

Intro to Digital Control	4
(EE 151)	
Image Processing	4
(EE 152)	
Fiber-Optic Communication Systems	4
EE 160	
Design for Reliability of Integrated Circuits and Systems (EE 165)	4
ELECTIVE COURSES UNITS (5 from above)	**20**

NOTE: The following courses were listed under multiple areas since they satisfy more than one requirement: Biological Sciences, CHEM001A, CHEM01LA, MATH009A, PHYS04A, PHYS040B, ENGR180W. The graduation unit requirement total is 188 (including the campus Ethnicity requirement) which accounts for only unique courses and unique units. There are a total of 27 units that overlap between breadth requirements, basic Math/Science, and Core requirements.

Based on the most recent catalog, EE students are required to take “One course in the biological sciences chosen from an approved list”. Courses that are approved include BIOL 005A/05LA, 003 and 002. BIOL 005A/LA is 5 units the other courses are 4 units.

The courses are structured to meet the overall PEOs that we have established, allowing our students to be successful in graduate school and their professions. The elective courses are the most advanced topics and most closely related to what the students may be doing in the future. As shown in Figure 5-1(a), our electives range the entire breadth of areas that EE graduates can work/study in, ranging from the design of circuits and systems, to advanced materials to topics that are more closely allied to computer science. The core courses are structured so as to meet the requirements for understanding the electives. These include basic signals and systems, logic design, circuit analysis, signals and systems, controls, digital signal processing and random processes in electrical engineering. The basic math and science courses are structured so as to meet the prerequisites for the core courses. Students get exposure to calculus, differential equations, linear algebra, complex variables, discrete math, programming and computer science. They also take a number of courses in physics and one course each in chemistry and biology. The general education is structured to provide students with a broad introduction to various fields of human knowledge. Table 5-4 below summarizes the major sub-divisions in the math, sciences and engineering courses as required under the EE Program Criteria. As shown in Table 4-2, we continuously monitor the progress of our students in meeting the requirements set in these courses and make changes as necessary.

Table 5-4: Math, science and engineering courses that meet the different requirements in the EE Program Criteria.

Mathematics through differential and integral calculus	MATH 9 A-B-C, MATH 10 A-B, MATH 46
Differential Equations	MATH 46, EE1A, EE1B, EE105, EE 132
Linear algebra, complex variables, discrete math	EE20, EE 1B, EE110AB, EE120AB
Probability and statistics, including applications	EE114
sciences (biological, chemical, or physical science)	PHYS 40 A-B-C, CHEM 1A, 4 units of BIO
Computer Sciences	CS 10-13-61, EE/CS 120A-B
EE Core	Table 5-3
EE Electives	Table 5-3 and Fig. 5-1 (b)

5.5 Design Experience

The Senior Design Project (EE175) is a rigorous two-quarter (recently modified to three quarters) course that provides students the experience of designing a real-life project. A group of instructors coordinate the course, give one-hour lectures each week, and meet weekly with student groups to advise the students on their design. Projects are either suggested by the instructors or proposed by students and approved by the instructors. The instructors ensure that all design projects have sufficient level of technical difficulty and make use of knowledge and skills from earlier electrical engineering courses. In fact, each project requires knowledge and skills from multiple EE courses, from circuits, logic design, electromagnetics, microcontroller programming to control, wireless communications, DSP, robotics, etc. We specifically require students to identify engineering standards and design constraints in their design projects. The requirements and an introduction to engineering standards and realistic design constraints are covered in a lecture. They are also required sections in the Final Report.

Below we provide specific details relevant to the 2011/2012 (and prior) offerings. The 2012/2013 offering will change to accommodate the three quarter sequence discussed under continuous improvements.

Prerequisites
Senior standing in Electrical Engineering, Engr 180W (Technical Communication).

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

The following are the specific course objectives and their mapping to the Student Outcomes.

1. Ability to understand the engineering design process, working in teams.
2. Ability to formulate design specifications and evaluation criteria; determining methodologies and performing solution analyses.
3. Develop skills in project management including organization, teamwork, planning, scheduling, and budgeting.
4. Develop skills in library techniques such as literature and information searching.
5. Develop technical writing and oral communication skills through proposal and report writing, as well as mid-course and final presentations.
6. Ability to design and conduct experiments and analyze data.
7. Understanding of professional and ethical responsibility.
8. Obtain a general understanding of engineering economics, marketing, career strategies, and resume preparation.
9. Understand the impact of engineering solutions in a global and societal context.
10. Knowledge of contemporary engineering issues.

Item	OUTCOME-RELATED LEARNING OBJECTIVES	OUTCOMES										
		A	B	C	D	E	F	G	H	I	J	K
1	Ability to understand the engineering design process, working in teams.			1	1	1					1	1
2	Ability to formulate design specifications and evaluation criteria; determining methodologies and performing solution analyses	1	1	1		1						1
3	Develop skills in project management including organization, teamwork, planning, scheduling, and budgeting			1	1	1					1	1
4	Develop skills in library techniques such as literature and information searching							1		1	1	1
5	Develop technical writing and oral communication skills through proposal and report writing, as well as mid-course and final presentations					1		1				1
6	Ability to design and conduct experiments and analyze data	1	1	1								1
7	Understanding of professional and ethical responsibility						1					1
8	Obtain a general understanding of engineering economics, marketing, career strategies, and resume preparation.						1		1	1		1
9	Understand the impact of engineering solutions in a global and societal context								1			1
10	Knowledge of contemporary engineering issues									1	1	1

Credits and Hours

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

Weekly Class Meetings

The entire class of EE175A and EE175B meets once each week for one hour. These meetings are intended to provide instruction in topics common to all design projects (engineering economics, ethics, etc.). In addition, it is expected that each project team meet with their faculty supervisor on a weekly basis to report and discuss the progress of the project. They may include brief presentations by each team, aimed at improving technical presentation skills. Attendance of the lectures and weekly meetings are mandatory.

Project Participants

Projects are completed in small teams with shared responsibility. If the team option is elected, each student will be held responsible for a distinct component of the total team effort. Prior to 2010, there are one or two individual projects in some years. To ensure a student working on individual projects still gains an understanding of team work on projects, all students must participate in group project reviews weekly to discuss their project progress and issues with other students in the same section. Starting in 2010, to ensure every student gains team work experience, we no longer allow projects with a single student. However, in 2010 and 2011, there was one single-student project each year due to special circumstances (a student dropped out of a 2-member team so only one student was left on one project).

Project Elements

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

Each design project must include the following components:

1. **A Clear Technical Design Objective and the Project Contract** (Contract due on Monday of week 3 of the winter quarter): Each group must identify a design project and sign the Contract by the due date, should have good estimated answers to the following questions, and obtain the endorsement of the section professor:
   - Is the objective achievable within two quarters?
   - Does the group have the expertise to complete the design, prototype, and testing?
   - Does the group have access to the financing for the prototype?
   - Does the group have access to the required test equipment?
   - Is this a design problem (not research, nor fabrication)?
   - Is the project significant enough to be worthy of eight credits (12 hours/week/person)?

2. **Experiment Design and Feasibility Study** (Required section in Final Report, 5% of final grade) Design and carry out experiments to evaluate the feasibility of project ideas, alternatives, trade-offs and realistic engineering constraints. Analyze the experimental results to prove the feasibility of your project idea and select the best solution to be further developed in the design project.

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

4. **Global, Economic, Environmental and Societal Impact** (Due on Monday of week 7 of the winter quarter, 2% of final grade): Each student must write an essay (500 or more words) providing an analysis of the potential global, economic, societal, and environmental impact of the project. You do not need to address every aspect, just focus on a couple of aspects that are related to your project. For example, if your project is made into a product, how will it: improve quality of life; affect the environment; enhance entertainment, education, globalization; etc.? Are there any ethical or political debates, laws and regulations that are related to your project?

5. **Contemporary Engineering Issues** (Due on Monday of week 8 of the winter quarter, 2% of final grade) Write an essay (500 or more words) on the contemporary engineering issues related to the project. Potential contemporary engineering issues related to your project are new technologies, new industry standards, new design methods, new materials, new trends in manufacturing, etc.

6. **Test Plan** (Required section in Final Report, 5% of final grade)**:** A detailed description of your design of experiments to test and measure whether the final product and each of its components meet the design specifications, and, if not, to test and measure the errors and deviations from specifications.

7. **Understanding of Professional and Ethical Responsibility** (Required section in Final Report, see grading below) Write an essay (500 or more words) on (a) what are the ethical implications of your project, (b) how you addressed them, and (c) what you learned through this design project about professional and ethical responsibility.

8. **Recognition of the need for and an ability to engage in lifelong learning** (Required section in Final Report, 2% of final grade) Write an essay (200 or more words) on how doing this design project helped you (a) recognize the need and (b) developed the ability in lifelong learning.

9. **Design Review Presentation** (Week 10 of the winter quarter, 5% of final grade): Each group must make a PowerPoint presentation of its design specification and progress to faculty and other students. Requirements of design review presentation will be provided.

10. **Detailed Quantitative Design and Prototype** (To be completed before week 8 of the spring Quarter): Each component of the selected solution and the overall system should be designed and implemented. In most cases, it is necessary to construct a system prototype (or component prototype).

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

12. **Final Presentation** (Week 10 of the spring quarter, 5% of final grade): Each group must make a PowerPoint presentation of the final design and show a working demo to faculty and other students. Requirements of final presentation will be provided.

13. **Working Demo and Final Report** (Due on Monday of the finals week in spring quarter before 5pm,): The final report must include all the required sections and appendices in a template file, final presentation ppt file and video or data of a working demo must be uploaded on the iLearn website for the course. A working demo of the completed design is critical, it is a convincing evidence that you design is completed and works. The demo should show whether and how design specifications are met.

Grading

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

1. **Laboratory Notebook, Weekly Progress and Lecture Attendance:** Each student team needs to maintain a laboratory notebook for the duration of their projects and report progress to the section instructor at least weekly. Each week, you must show evidence of amount of work done and progress in the design, implementation and/or testing. Attendance of the lectures is mandatory. Everyone must sign in at each lecture. (This portion accounts for 7.5% of grade).

2. **Professional Ethics and Responsibility** (7.5% of the final grade): You will be evaluated by your team member(s) and by your section instructor. See the attached evaluation forms on how this is graded.

Grading is determined by all of the section professors conferring on each project and student. Please note that grades are assigned to an individual, not to a project.

Project Topics

Projects may be carried out in the four main electrical engineering focus areas at UCR. Each section will have a “section professor” (i.e., faculty supervisor). Possible project topics are obtained from or approved by the section professor. In addition, joint projects with other departments may be arranged. Topics that each section professor will supervise are presented to the students in an information meeting held in the fall quarter.

Steps in Selecting a Project

Upon reviewing the topic areas, students take the following steps to select a project, and sign the corresponding senior design contract (available on iLearn).

Step - 0: Prepare a brief academic resume, which describes the specific technical strengths and general background in less than two pages. It is very important that the students make a case for themselves as to why they should be doing a specific project. This step is more or less like applying for a job, and therefore this resume is the first draft of your future resume that opens a door for them. Then they follow one of the following Steps 1A to 1C, depending on their situation.

Step - 1A: Meet and talk to the section professor, and find out if the professor offers a project that interests the student and he/she considers the student qualified to do the project. Or,

Step - 1B: If they have an industrial project in mind that meets the requirements stated above, then they still need to talk to the EE175 section professor. This professor must approve and supervise the project. Or,

Step - 1C: If they have their own project, they must lobby for that idea with their section professor. This approach requires additional effort, but is doable if it is planned in advance.

Step - 2: Identify one or possibly two classmates who have similar interests, complementary skills, and want to work with the student on the same project and have gone through the same steps. Discuss the project among team members and achieve a consistent project idea.

Step - 3: Make a brief written proposal to the section professor that includes resume, classmate(s) resume(s) if applicable, the title of the project, and a brief description. Also have one or more projects in this proposal as the second or third choices. Please note that every effort is made to match the student with his/her best choices, although in certain instances changes may be required.

Step – 4: Once the projects are verbally approved by the section professors, each student team is to fill out a project contract available on the class web site.

Course Organization

The following is a typical organization of the course (sample from 2011-12 academic year).

Date	Week	Lecturer	Lecture Content
1/13	Week 01	PL, RC, EP	Introduction, course outline, preliminary issues, requirements and expectations
1/20	Week 02	RC	Design methodologies and approaches; block diagrams, analysis of solutions, evaluation of feasibility.
1/27	Week 03	EP	Introduction to the design process, specification process, laboratory notebooks, library techniques, literature and information search
2/3	Week 04	RC	Experiment design, developing a test plan, collecting data, and evaluation. Design constraints, industry standards
2/10	Week 05	EP	Project management: organization, teamwork, scheduling, budgeting, etc.
2/17	Week 06	RC	Systems engineering

2/24	Week 07	RC	Engineering ethics (exam given at the end of the lecture)
3/2	Week 08	RC	Contemporary engineering issues, societal, environmental and cultural impact, international engineering projects
3/9	Week 09	EP	Lab skills and exam for gaining lab access
3/16	Week 10	ALL	No lecture. Design Review presentations. Time TBA
			Lecture time for Spring quarter is tentative and subject to change
4/6	Week 01	PL	Career choices and strategies, how to write resumes
4/13	Week 02	EP	Printed circuit board design, layout, and fabrication
4/20	Week 03	RC	Data analysis techniques
4/27	Week 04	RC	Writing Technical reports
5/4	Week 05	PL	Engineering economics, marketing engineering products
5/11	Week 06	PL	Patents and intellectual properties
5/18	Week 07	RC	Final testing requirements, test report, preparation for the final presentation
5/25	Week 08	PL	Entrepreneurial, venture capital and start-ups
6/1	Week 09	PL	TBA
6/8	Week 10	ALL	Last week, no lecture. Final Presentations. Demo required. Time TBA

Design Experience

The design experience follows the same process as practice in industry. Under the supervision of the instructor, students start with project definition and feasibility study, and go through one or more iterations of specification, design review, prototyping, testing and revision. Students are also responsible to project management including budgeting, researching and ordering parts, task definition, assignment and scheduling. The design process also requires them to consider applications, engineering and professional ethics and potential societal impact of their design projects if they were to be marketed as a product. This design process gives them a first understanding and experience of a design project and as a result it prepares them for engineering practice after they graduate.

1. From early on in the project students face the necessity to follow the fundamental design cycle phases:

- **Exploration** (study of possibilities and constraints);
- **Redefinition** (specification of design solutions)
- **Management** (time management, budget management, supply chain management);
- **Prototyping** (subsystem scenarios, interfacing, data communication protocols, etc.);
- **Redesign** (system changes due to efficiency or newly discovered constraints).

2. The complexity of project systems requires their subdivision into multiple subsystems grouped either by their function, e.g., signal conditioning, digital/analog control, power amplifiers, etc. or, by work separation among project team-members, e.g., a lead member in sensor interfacing, data communication and protocol development or, in electric drives and control, or in telemetry and sensor design, etc.

3. Assembly of project subsystems requires a preparation of test plans and test reports; requires conducting relevant data analysis and a development of subsystems' specifications.

4. Final system testing, validation and verification, and final design report preparation are other strict project requirements.

Knowledge and Skills Acquired in Earlier Coursework

The course instructors ensure all projects contain sufficient technical complexities that require both knowledge and skills acquired in earlier coursework and new knowledge and skills the students must learn in the design process. This is best shown by examples of actual design projects.

Multiple projects on wireless ECG and EEG Monitors that transmits ECG/EEG signal via Bluetooth to a smartphone or computer which records and plots the data in real time: These projects require knowledge and skills acquired in earlier coursework including circuits and electronics (EE1AB, EE100AB), logic circuits and microcontroller (EE120AB, EE128), sampling and signal processing, A/D conversion (EE110AB, EE141), programming and computer organization (CS10, CS13, CS61), technical writing (ENGR180), communications (EE115), and also requires students to learn about wireless personal area networking and the associated Bluetooth industry standard, electrodes and biomedical properties of ECG and EEG signals. In addition to the general design constraints listed in the next section, the specific constraints of these projects may include: processor speed, data rate, transmission range, memory size, parameters of available amplifiers and filters.

A wide range of projects on robotic vehicles (Sumo Robot, micromouse, cleaning robot, autonomous navigation robots): These projects require knowledge and skills acquired in earlier coursework including circuits and electronics (EE1AB, EE100AB), logic circuits and microcontroller (EE120AB, EE128), sampling and A/D conversion (EE110AB), control (EE105, EE132, EE151), robotics (EE144 which some students took, other students who did not will acquire the needed knowledge through the design project), programming and computer organization (CS10, CS13, CS61), technical writing (ENGR180), and also requires students to learn about motor control, various sensors (infrared, ultrasound, accelerometer, gyros), inertial based navigation and GPS (for projects that require it), wireless networking (Bluetooth, 802.11, for projects that require remote control and data transmission) and the associated multiple industry standards. In addition to the general design constraints listed in the next section, the specific constraints of these projects may include processor speed, sampling rate, data rate, traveling speed and/or time, transmission range, memory size, accuracies of the sensors, parameters of motors and drive circuits.

Below are additional example projects to illustrate the above.

Project Title	Subproject Activity	Related EE Program Coursework
EE175-12-11 **Quad-Rotor Helicopter**	Sensors, Signal Conditioning and other Electric Circuits	EE001A, EE100A, EE100B, EE116, EE128, EE136
	Signals and Systems, Data Analysis and Processing	EE020, EE110A, EE110B, EE114, EE115
	Control Systems, Inertial	EE105, EE132, EE141

	Navigation Units and Analog/Digital Signal Processing	
	Embedded System Design	EE120A, EE120B, EE128, CS61
	Networks and Data Communication	EE115, EE150
	Software Development	CS005, CS61, EE128, EE143
	System Design, Constraint Analysis, Industry Standards, Budgeting, Subsystem Test Plans, Technical Reporting, System Validation and Verification	EE175A, EE175B (lectures)
EE175-12-01 Low-Power AC/DC Digital Wattmeter	Signal Conditioning and other Electric Circuits	EE001A, EE100A, EE100B, EE128
	Signals and Systems, Data Analysis and Processing	EE020, EE110A, EE110B, EE114, EE115
	Digital Signal Processing and Control	EE105, EE141
	Embedded System Design	EE120A, EE120B, EE128, CS61
	Networks and Data Communication	EE115, EE150
	Software Development	CS005, CS61, EE128, EE143
	System Design, Constraint Analysis, Industry Standards, Budgeting, Subsystem Test Plans, Technical Reporting, System Validation and Verification	EE175A, EE175B (lectures)
	Software Development	CS005, CS061, EE128

	System Design, Constraint Analysis, Industry Standards, Budgeting, Subsystem Test Plans, Technical Reporting, System Validation and Verification	EE175A, EE175B (lectures)
Other projects include elements of	Computer Vision and Image Processing	EE146, EE152
	Robotics	EE144
	Advanced Electromagnetics, and Magnetism and Magnetic Materials, and related Sensors	EE117, EE138, EE139
	Optoelectronics and related Sensors	EE136

Engineering Standards and Multiple Design Constraints
Every design project involves industry standards, some more and some less, depending on what is being designed. The most widely involved standards are interfacing standards, e.g., I2C, SPI, RS232/UART, USB, etc.

All projects face constraints of time (only two quarters of time), skill (inexperienced, first design project ever), and budget. All projects also face the constraints of power consumption, weight, and size, to varying degrees. Other constraints are specific to each project. See the projects listed above for examples.

5.6 Cooperative Education
Not applicable. Our program does not allow cooperative education to satisfy curricular requirements.

5.7 Materials Available for Review during the Site Visit
For each course, the EE program has maintained an electronic folder that details the syllabus, homework and lab assignment and solutions, student outcomes, sample student work, assessment of student outcomes, and changes that have been made and are recommended for the future, among others. All the course folders will be available to the ABET reviewers. All the documents will be available electronically. If the reviewer so desires, we can have all the material available remotely prior to the visit. Please email the contacts given on the first page of this document for the access information.

5.8 Course Syllabi

A syllabus for each course is provided in Appendix A.

CRITERION 6. FACULTY

6.1 Faculty Qualifications

The Electrical Engineering faculty is a professionally active, diverse group whose activities and expertise are well-balanced across the four general instructional areas of the department: (1) nano materials, circuits and devices, (2) control and robotics, (3) intelligent systems, and (4) communications and signal processing. The current faculty size is 22 faculty members with 19.1[4] FTE tenured/tenure-track professors. Ongoing searches for faculty are strategically conducted to identify and attract outstanding faculty with a strong foundation in the basic EE sciences and research interests confluent with the department's strengths and towards emerging research in electrical engineering, including sustainable energy storage and distribution systems; communications, sensing, and imaging; computing circuits and systems; and electronic materials and devices.

The research activities of the Electrical Engineering fall within each of the four general instructional areas. Faculty involved in the research area of nano materials, circuits and devices focus on the theoretical, computational and experimental investigation of nanostructures and development of novel bio-, opto- and electronic materials, devices, and circuits, and MEMS. Professors Balandin, Haberer, Korotkov, Lake, Liu, Ozkan, Tan, and Wang are involved in research and instruction in this area. Prof. Tan also conducts research and teaching in VLSI design. In addition, Professor Wang is the Director of the Center for Ubiquitous Communication by Light (UC-Light), one of the Bourns College of Engineering's four major research centers. Faculty involved in the research area of control and robotics investigate theories and methodologies of modeling, identification and design of control systems and cyber-physical systems, as well as the planning, analysis of motion, navigation, and control of autonomous vehicles and robotic systems. Professors Chen, Farrell, Hackwood, Mourikis, Qi, and Ren are involved in research and instruction to this end. Professor Hackwood is a Governor's appointee as the Director of the California Council on Science and Technology. Professors Barth, Bhanu, Liang and Roy-Chowdhury conduct research and instruction in intelligent systems, developing theories and tools for computer visualization, graphics, machine learning, pattern recognition, intelligent transportation systems, and intelligent vehicle technology. In addition, Professor Barth is the Director of the Center for Environmental Research and Technology, and Professor Bhanu is the Director of the Center for Research of Intelligent Systems, two of the Bourns College of Engineering's four major research centers. Finally, Professors Dumer, Hua, Tuncel, and Xu conduct research and instruction in the area of communication and signal processing, investigating and developing communication and signal processing theories, algorithms and systems for wireless and network communications, video and multimedia technologies. These four major research areas, coupled with the program in Computer Engineering, cover all major areas of electrical engineering; furthermore, collaborative interdisciplinary lecturers and workshops with other departments facilitate undergraduate exploration of engineering applications in other fields.

[4] The 0.1 FTE reflects the appointment of a faculty member with a 90% Governor's appointment as Director of the California Council on Science and Technology. J. Chen and D. Xu are on long-term leave.

The EE faculty's diversity of experience in both industry and academia expose students to a broad range of instructional and experimental approaches. The faculty analysis in Table 6-1 shows the broad educational backgrounds of the faculty and the high emphasis placed on service and active participation in professional societies; this can also be seen in greater detail in the curriculum vitae provided in Appendix B, which demonstrate the faculty's extensive involvement on top editorial boards, international program committees, and their recognition by national and international awards. For example, the EE faculty has 7 IEEE Fellows, 7 AAAS Fellows, 6 NSF Career Awardees, 3 ARO or ONR Young Investigator Awardees, 2 SPIE Fellows, 1 OSA, 1 IAPR, 1 IOP, 1 IFAC, and 1 APS Fellow. These tables substantiate the capabilities of EE faculty to provide the highest quality instruction in all the general research areas, and also to guide student investigation of more specialized topics within these areas.

Overall, the department faculty comprises thirteen full professors, four associate professors, and three assistant professors; three faculty members are women.

6.2 Faculty Workload

The standard teaching load for ladder-rank faculty is four courses per three-quarter academic year, the load for Assistant Professors is three courses per year, and faculty performing significant university service[5] also receive course relief with the Dean's approval. All tenured and tenure-track faculty hold a Ph.D. in Electrical Engineering, and have degrees in fields as diverse as Physics, Mathematics, Computer Science, Materials Science, Metallurgical Engineering, Aerospace Engineering, Business Administration, and Electrical Engineering. In addition to the full-time faculty, highly qualified and motivated adjunct faculty from industry and lecturers participate in our undergraduate and graduate teaching enhance the curriculum with their unique backgrounds and experience.

[5] Significant university service appointments that currently receive course relief include department appointments as Department Chair, Graduate Program Advisor, Undergraduate Program Advisor, and ABET Coordinator; Bourns College of Engineering appointments as Director of a major Center; and campus appointments to the Committee on Academic Personnel.

Table 6-1. Faculty Workload Summary (2011-2012) [6]

Faculty Member (Name)	FT or PT	Classes Taught (Course No. /Credit Hrs.)	Total Activity Distribution: Teaching Term	Teaching Year	Research Term	Research Year	Other Term	Other Year	Other service (if applicable)
Balandin, Alexander	FT	EE 190 (11F),EE202 (12W), EE 216 (12S)		20%		50%		30%	MSE Program Chair
Barth, Matt	FT	EE 128 (11F), EE 197 (12W)		20%		50%		30%	CE-CERT Director
Bhanu, Bir	FT	EE 276 (11F), EE 275 (12W), EE 276 (12W), EE 224 (12S), EE 276) (12W)		20%		50%		30%	CRIS Director
Dumer, Ilya	FT	EE 115 (11F), EE 150 (12W), EE 224 (12W), EE 225 (12S)		30%		50%		20%	
Farrell, Jay	FT	EE 105 (12W), EE 236 (12W),		30%		50%		20%	
Haberer, Elaine	FT	EE 138 (11F), EE 203 (12S)		30%		50%		20%	
Hua, Yingbo	FT	EE 110A (11F), EE 210 (12W), EE 211 (12S), EE 226 (12S)		30%		50%		20%	
Korotkov, Alexander	FT	EE 133 (11F), EE 201 (11F), EE 100A (12W)		40%		40%		20%	
Lake, Roger	FT	N/A		0		100		0	Sabbatical
Liang, Ping	FT	EE 141 (11F), EE 175A (12W), EE 175B (12S)		30%		40%		30%	EE Undergraduate Advisor
Liu, Jianlin	FT	EE 190 (12W), EE 136 (12S), EE 206 (12S)		20%		50%		30%	
Mourikis, Anastasios	FT	EE 230 (11F), EE 146 (12W), EE 144 (12S)		40%		40%		20%	
Ozkan, Mihri	FT	EE 137 (12W)		20%		60%		20%	
Ren, Wei	FT	EE 235 (11F), EE 237 (12W), EE 151 (12S)		40%		40%		20%	
Roy Chowdhury, Amit	FT	EE 247 (12W), EE 114 (12S)		20%		50%		30%	ABET Coordinator
Tan, Sheldon	FT	EE 120A (12W)		20%		50%		30%	CmpE Undergraduate Coadvisor
Tuncel, Ertem	FT	EE 215 (11F), EE 110B (12W), EE 259 (11F, 12W, 12S)		20%		50%		30%	Graduate Advisor
Wang, Albert	FT	EE 135 (12S), EE 221 (12S),		20%		50%		30%	UC Light Director

[6] Jie Chen and Daniel Xu are on long-term leave. Susan Hackwood has a 10% appointment. They are not included in this table.

Zhu, Qi	FT	EE 120A (11F), EE 134(12W)		30%		50%		20%	
Abou-Galala, Feras	PT	EE 001A (11F), EE 001B (11F), EE 110A (12W), EE 020 (12S), EE 110B (12S), EE 132 (12S)		100%					
Amos, Nissim	PT	EE 100B (12S)		100%					
Chen, Gang	PT	N/A				100%			
Chomko, Roman	PT	EE 100A (11F), EE 100B (12W), EE 139 (12W), EE 175A (12W), EE 001A (12S), EE 116 (12S), EE 175B (12S)		100%					
El-Sherief, Hossny[7]	PT	EE 001B (12W)		100%					
Khitun, Alexander	PT	N/A						100%	
Khizroev, Sakhrat	PT	N/A		20%		60%		20%	

[7] For all part-time Adjunct faculty and Lecturers, the percentages in the "Other" category represent time spent through their regular employment outside of the university

TABLE 6-2 (a). FACULTY ANALYSIS - TENURED[8]

Name	Rank	FT or PT	Highest Degree	Institution from which Highest Degree Earned & Year	Years of Experience			State in which registered	Level of Activity (high, med, low, none) in:		
					Gov't./Industry Practice	Total Faculty	This Institution		Professional Society (Indicate Society)	Research	Consult/ Smr. Work in Industry
Balandin, Alexander	P (T)	FT	Ph.D.	University of Notre Dame, 1997	0	13	13		High (IEEE, APS, OSA, SPIE, IOP, MRS, ECS)	High	High
Barth, Matthew	P (T)	FT	Ph.D.	UC Santa Barbara, 1990	1	17	17		IEEE: High Trans. Rsch. Board: High ITS America: Med.	High	Low
Bhanu, Bir	P (T)	FT	Ph.D.	University of Southern California, 1981	9	25	22		IEEE: High	High	High
Dumer, Ilya	P (T)	FT	Ph.D.	Institute for Problems of Information Transmission Russian Academy, 1981	0	17	17		High (IEEE)	High	Low
Farrell, Jay	P (T)	FT	Ph.D.	University of Notre Dame 1989	4.5	18.5	18.5		High (IEEE)	High	Medium
Hua, Yingbo	P (T)	FT	Ph.D.	Syracuse Univ., 1988	2	21	11		High (IEEE)	High	Medium
Korotkov, Alexander	P (T)	FT	Ph.D.	Moscow State Univ., 1991	0	13	12		Medium	High	None
Lake, Roger	P (T)	FT	Ph.D.	Purdue University 1992	7	12	12		IEEE(High), APS(Low), MRS(Low), AAAS(Low)	High	Low
Liang, Ping	ASC (T)	FT	Ph.D.	University of Pittsburgh, 1987	5	20	20		IEEE: Med	Med	Med
Liu, Jianlin	P (T)	FT	Ph.D.	UC Los Angeles, 2003	0	9	9		High (IEEE, MRS)	High	None
Ozkan, Mihrimah	P (T)	FT	Ph.D.	UC San Diego, 2001	0	11	11		High	High	None
Ren, Wei	ASC (T)	FT	Ph.D.	Brigham Young University 2004	0	8	1		High (IEEE)	High	None

[8] Jie Chen and Daniel Xu are on long-term leave. Susan Hackwood has a 10% appointment. They are not included in this table.

Roy-Chowdhury, Amit	ASC (T)	FT	Ph.D.	University of Maryland, College Park 2002	?	8	8		High (IEEE, ACM)	High	Medium
Tan, Sheldon	P (T)	FT	Ph.D.	Univ. of Iowa, 1999	3	10	10		Medium	High	Medium
Tuncel, Ertem	ASC (T)	FT	Ph.D.	UC Santa Barbara, 2002	0	9	9		High (IEEE)	High	None
Wang, Albert	P (T)	FT	Ph.D.	State University of New York, Buffalo, 1996	5	14	5		IEEE: High	High	Low

FACULTY ANALYSIS - UNTENURED

Name	Rank	FT or PT	Highest Degree	Institution from which Highest Degree Earned & Year	Years of Experience			State in which registered	Level of Activity (high, med, low, none) in:		
					Gov't./Industry Practice	Total Faculty	This Institution		Professional Society (Indicate Society)	Research	Consult/ Smr. Work in Industry
Haberer, Elaine	AST (TT)	FT	Ph.D.	UC Santa Barbara 2005	0	4	4		MRS: Low	High	None
Mourikis, Anastasios	AST (TT)	FT	Ph.D.	University of Minnesota 2008	0	4	4		IEEE Robotics Society: Low	High	None
Zhu, Qi	AST (TT)	FT	Ph.D.	UC Berkeley, 2008	3	1	1		IEEE, ACM: Low	High	Low

TABLE 6-2 (b). ADJUNCT FACULTY & LECTURER ANALYSIS

Name	Rank	FT or PT	Highest Degree	Institution from which Highest Degree Earned & Year	Years of Experience			State in which registered	Level of Activity (high, med, low, none) in:		
					Gov't./Industry Practice	Total Instructional	This Institution		Professional Society (Indicate Society)	Research	Consult/ Smr. Work in Industry
Abou-Galala, Feras	I (NTT)	PT	Ph.D.	Ohio State University, 2007	0	4.5	4.5		IEEE: Low	None	None
Amos, Nissim	I (NTT)	PT	Ph.D.	University of California, Riverside 2008	3	2	3	CA	IEEE – Med	High	High
Chen, Gang	A (NTT)	PT	Ph.D.	Shanghai Institute of Optics and Fine Mechanics (SIOM), Chinese Academy of Sciences (CAS), China, 2004	0	15	6		SPIE and IEEE: High	High	Low
Chomko, Roman	I (NTT)	PT	Ph.D.	University of Miami, 1999	0	6	4		None	Medium	Medium

El-Sherief, Hossny	A (NTT)	PT	Ph.D.	McMaster University, Canada 1979	31	11	14		None	Low	High
Khizroev, Sakhrat	A (NTT)	PT	Ph.D.	Carnegie Mellon University 1991	5	8	6		N/A	High	High
Khitun, Alexander	A(NTT)	PT	Ph.D.	Applied Physics and Mathematics, Moscow Institute of Physics and Technology (MIPT), Russia 1995	0	3	0		Optical Society of Southern California – low	High	None

Glossary for the above table:

A ....Adjunct
ASC ....Associate Professor
AST ....Assistant Professor
FT ....Full-time
I ....Instructor
NTT ....Non Tenure Track
O ....Other
P ....Professor
PT ....Part-time
T ....Tenured
TT ....Tenure Track

6.3 Faculty Size

The faculty cover all the broad areas of the department as mentioned above and summarized in Table 6-3. All required courses are covered by the tenured/tenure-track faculty and lecturers. Faculty are actively involved with the students. Each faculty holds weekly office hours for the students in their courses. They serve on various committees that look into student evaluation and curriculum. University service consists primarily of involvement in department and college committees, as well as Academic Senate committees (as per the shared governance structure of the University of California).

The department's aggressive approach to growing FTE faculty is due in part to a commitment to preserving its low student-to-faculty ratio as undergraduate enrollment grows. EE courses are generally capped at 30 students, allowing all undergraduate students to interact on a personal level with faculty. Enrollment in core required classes such as EE 1A/B, EE 100A/B, EE110A/B can be as high as 60-80 students for the lecture component; however, these classes require a lab component, which is led by teaching assistants and contains no more than 32 students per lab. All faculty hold regular office hours to meet with students on a drop-in basis.

6.4 Professional Development

All faculty in the EE Program actively participate in research activities and some have large research groups funded from extramural grants and contracts. This requires them to be up-to-date on the latest developments in the field by reading journals, attending conferences, participating in government panels, and reviewing activities. Moreover, many of the faculty are involved in consulting activities (university policies allow one day/week for outside consulting activities).

Faculty members have resources from initial complements, "various donors" funds, and contract and grant awards to travel to meetings and conferences in their disciplinary areas or in engineering education. Additional funds are available from the College, the campus, and the Faculty Senate. It is common for new faculty hires to have money in their initial complements for travel to meetings of professional societies or other scholarly events. Later in their careers, grant funding typically supports the cost of travel to meetings and conferences, where they share research results. The fact that all EE faculty are research active demonstrates that these resources are sufficient to assure that professors are able to maintain currency in their fields.

The departments and degree programs cooperate to present lecture series every academic year. These series bring faculty candidates and distinguished guests from academia or industry to campus. Faculty and students attend these sessions. Professional development opportunities include workshops on teaching skills, interpersonal skills, and other matters. State law and University policy also require training in sexual harassment prevention, laboratory safety, and other matters.

For the past few years, the National Science Foundation has required grantees to provide training in responsible conduct of research (RCR) to all trainees who are paid on NSF grants. In response, UCR and the College have established training resources including an on-line tutorial, and departments are encouraged to include topics in research ethics and engineering ethics in their lecture series and courses. By being required to train their students in RCR, faculty members continually refresh themselves in this subject area. Similarly, NSF requires postdoctoral trainees who are supported by its grants to be mentored by their faculty advisors so they can become independent investigators. This mentoring takes many forms but requires faculty members to maintain their skills as mentors.

6.5 Authority and Responsibility of Faculty

The three main responsibilities of the faculty involve Teaching, Research and Service. The teaching responsibilities are summarized in Table 6-1 in terms of the courses taught in the last academic year. The normal course load is 4 courses per year for tenured faculty and 3 courses per year for non-tenured faculty. In 2011-12, 78% of EE courses were taught by tenure-track faculty. The major service responsibilities in their professional societies are also highlighted in Table 6-2. All faculty are actively involved in research and their specializations can be roughly categorized as shown in Table 6-3 (many faculty crossover between disciplines). The main service responsibilities within the department are shown in Table 6-4.

Table 6-3. Major Research Areas of the Faculty. The number of students being advised currently in shown in parenthesis.

Research Areas	Faculty
Nanotechnology, Advanced Materials and Devices	Balandin (8), Haberer (2), Lake (6), Liu (9), Korotkov (3), Ozkan (6)
Intelligent Systems	Barth (5), Bhanu (18), Mourikis (2), Roy-Chowdhury (12)
Communications, Signal Processing and Networking	Dumer (2), Hua (4), Liang (2), Roy-Chowdhury (12), Tuncel (2), Xu (2)
Controls and Robotics	Chen (2), Farrell (6), Mourikis (2), Ren (2)
VLSI	Tan (6), Wang (7), Zhu (1)

The faculty are also involved in the evaluation and continuous improvement process. Please refer to Figure BG-6 and Figure 4-3 to see the role of the faculty, including those in administrative positions. These two figures illustrate the consultation and approval process by which the faculty guide the EE program.

The faculty discuss the PEOs and Student Outcomes (at least) in the Spring in preparation for and in response to the BOA meeting. This also ensures analysis of most of the data collected over the year. If any changes are approved by the faculty, due to the fact that the PEOs are listed in the UCR catalog, the changes require approval by the BCOE Executive Committee and Academic Senate. The BCOE Dean and Associate Dean of Undergraduate Education are both ex-officio members of the BCOE Executive Committee.

All program issues are initiated by the Departmental faculty either as individuals or as members of the UG committee. The UG committee reviews the survey data. The ABET Coordinator and the Chair of the UG Committee, who is the UG Advisor, both attend the BOA meeting. They present both recent and planned programmatic changes and receive comments and feedback. Many of the faculties devise new courses as technical electives based on their research expertise.

Changes in program must be approved by a vote of the Departmental faculty and also the Executive Committee of the College of Engineering as shown in Fig. 4-4 earlier.

Table 6-4. 2011/2012 Committee Responsibilities of EE Faculty

EE Committee Assignments 2010-2011

NAME		Graduate	EE Undergraduate/ABET	Awards	Search	CE Undergrad	Comments
BALANDIN	P				member		MSE Chair
BARTH	P						CE-CERT Director
BHANU	P						CRIS Director
CHEN	P						On Leave
DUMER	P			**Chair**			
FARRELL	P						Chair BCOE, Chair EE
HABERER	Asst.		MSE liason				
HACKWOOD	P						10% Apt.
HUA	P	SP/Comm			member		
KOROTKOV	P	NMDC					
LAKE	P						Sabbatical
LIANG	AP		**Academic Chair**				
LIU	P		NMDC				Director Microelectronics Laboratory
MOURIKIS	Asst.	I.S., Robotics, Control					
OZKAN	P						
REN			Systems & Control				
ROY CHOW.	AP	IS	**ABET Chair**				
TAN	P		CE liason			**Vice-Chair**	
TUNCEL	AP	**Grad. Advisor**					
WANG	P				Chair	Member	UC-Light Director
XU	P						On Leave
ZHU		CmpE					
NAJAAR						**Chair**	

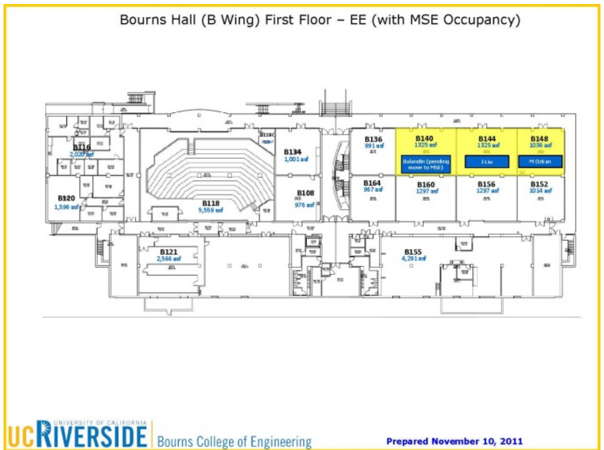
CRITERION 7. FACILITIES

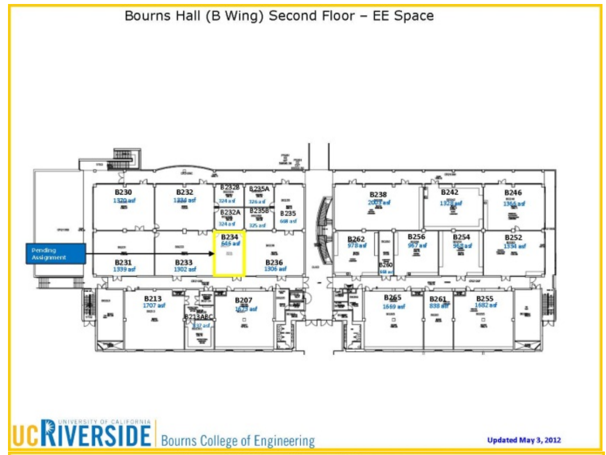
7.1 Offices, Classrooms and Laboratories

The Bourns College of Engineering occupies portions of Bourns Hall (approximately 105,000 assignable square feet with wet labs, classrooms, and offices), Winston Chung Hall (approximately 104,000 square feet with dry labs, classrooms, and offices), and the Materials Science and Engineering Building (approximately 77,000 assignable square feet with wet labs, classrooms, and offices). Bourns Hall opened in 1995. Winston Chung Hall opened in 2005 and the MSE Building opened in 2011.

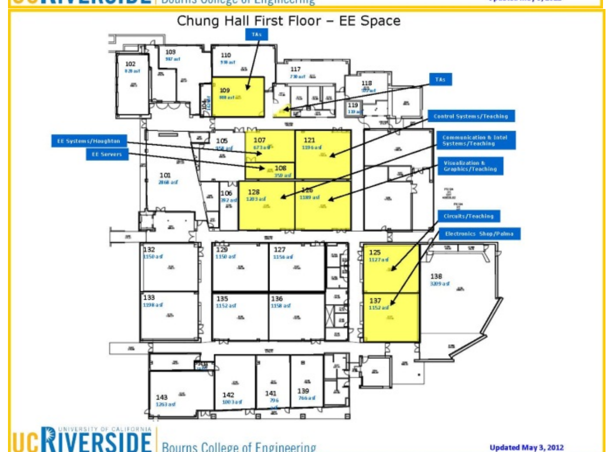
While the Department of Electrical Engineering has dedicated space in all three buildings (see Figure 7-1), due to programmatic needs, the vast majority of the EE Department space is in Winston Chung Hall (WCH). The EE department's administrative office is in WCH 345. The EE faculty offices are on the third and fourth floors of WCH. The EE Shop, EE Systems Group office, and EE teaching labs are on the first floor of WCH. The faculty research labs are distributed across the three buildings depending on the facilities (wet space, clean room, etc.) required for their projects. The three engineering buildings are designed to be collaborative, including numerous meeting spaces and conference rooms, of various sizes, that are shared by all departments.

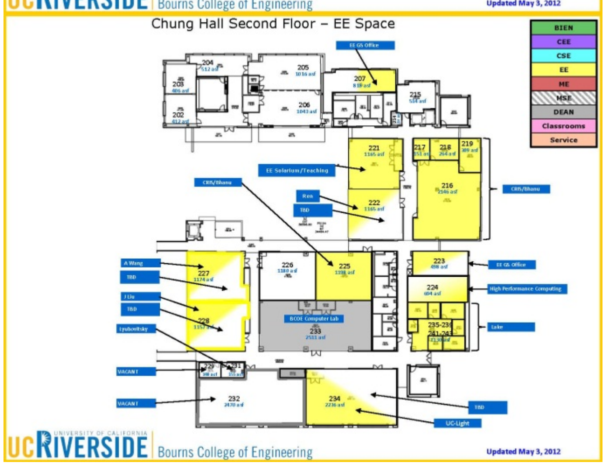
The engineering buildings include classrooms of various capacities, as do most buildings on campus. The assignment of classrooms for each course is made as a joint effort between the BCOE Student Affair Office and the Scheduling Office of the UCR Registrar. For each course, the BCOE Student Affair Office requests for a room from the Scheduling Office providing the enrollment for the individual class. The UCR Scheduling Office then assigns a campus room based on with the best availability to accommodate the size of the class. Special requests for additional lectures, tutorials, discussions, and examinations can be made by the instructor directly within BCOE. The TA office in Winston Chung Hall sometimes can be used to hold additional tutorials with prior arrangements.


Bourns Hall (B Wing) First Floor – EE (with MSE Occupancy)
UC RIVERSIDE Bourns College of Engineering
Prepared November 10, 2011


Bourns Hall (B Wing) Second Floor – EE Space
Pending Assignment
UC RIVERSIDE Bourns College of Engineering
Updated May 3, 2012


Bourns Hall (B Wing) Third Floor – EE Space
UC RIVERSIDE Bourns College of Engineering
Updated May 3, 2012


Chung Hall First Floor – EE Space
UC RIVERSIDE Bourns College of Engineering
Updated May 3, 2012


Chung Hall Second Floor – EE Space
BIEN
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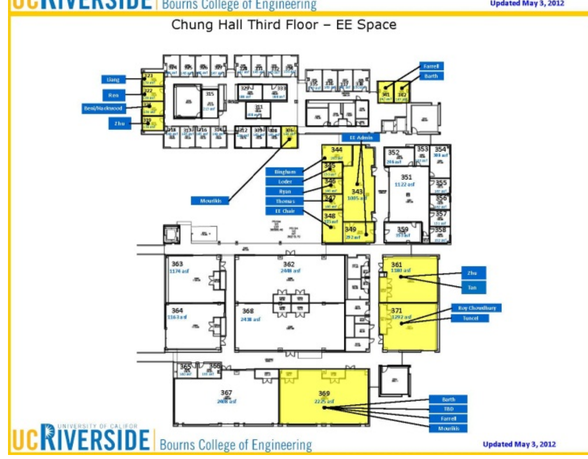
UC RIVERSIDE Bourns College of Engineering
Updated May 3, 2012


Chung Hall Third Floor – EE Space
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Updated May 3, 2012

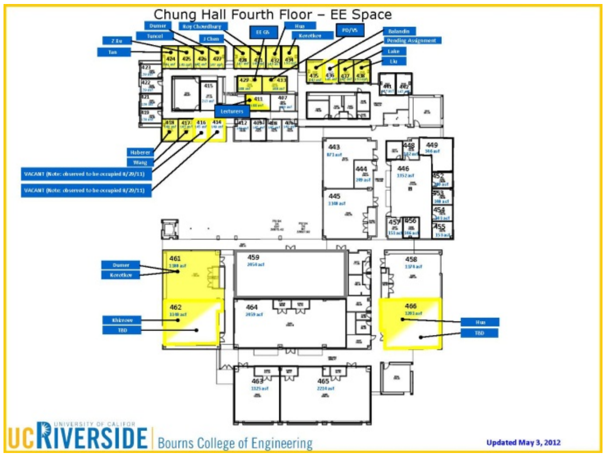

Figure 7-1. Dedicated Electrical Engineering space in the UCR engineering complex

As noted in the Curriculum section and syllabi, several courses require student lab experiences. Table 7-1 lists the EE instructional laboratory space.

Table 7-1. Instructional laboratory spaces for electrical engineering courses.

Courses	121: Circuit & Control	125: Embedded Systems & Logic Design	126: Adv. Systems & Sr. Design	128: Comm & Intelligent Systems	137: Electronics & Prototyping Shop	228: Nano Charact.	B234: Photonics Devices	234: Computer Lab
1AB 2	x							24 hr access
100 A/B	x							
105	x			x				
115 117				x				
120A		x						
128 134				x				
135 140				x				
132 144	x							
136						x		
141/146 152				x				
160							x	
175A/B		x	x	x	x	x		
ENG 10/ IEEE						x		

In particular, there are four major instructional laboratories:

1. Circuits and Control Systems Lab located in WCH 121
2. Embedded Systems and Logic Design Lab in WCH 125
3. Advanced Systems and Senior Design Lab in WCH 126
4. Communication and Intelligence Systems Lab in WCH 128

These four labs are furnished with approximately 16 workbenches. For the labs in WCH 121, 126, and 128, each workbench is equipped with an oscilloscopes, digital multimeter, function generator, power supply, and desktop computers. Each workstation in WCH 125 only has and only needs power supplies and computers. Some fully-licensed and well-known software/tools are provided on the computers for students' use, such as Cadence, Orcad, PSpice, Matlab, and Codewarrier C Development. Through such industrial standard software, students have an opportunity to gain the knowledge to utilize and manipulate the software while achieving the objectives for the certain courses. This experience is progressively reinforced from the sophomore year to graduation.

These labs provide the infrastructure to support excellent educational and instructional opportunities to students during their academic years at the College. There are also two non-instructional laboratories in Winston Chung Hall: the Electronics & Prototyping Shop at WCH 137 and the Computer Lab at WCH 234. The Electronics & Prototyping Shop provides and maintains all the equipment and accessories used in the laboratories. The Computer Lab provides a computing environment that provides students with access to use of a number of very powerful fully-licensed software when working on assignments.

All labs discussed above have wired internet access. Wireless access for student computers is ubiquitous across the UCR campus.

All instructional laboratories except 234 are located on the ground floor of Winston Chung Hall. They are managed by the technical staff. Each laboratory occupies an area of approximately 900 sq. ft. and has 16 workstations each. The maximum capacity for each lab is 32 students with 2 students per workstation. When the enrollment of a class exceeds the maximum allowable capacity in the lab, then additional lab sections are offered. The number of sections of each course in each quarter is public information searchable at www.classes.ucr.edu.

7.2 Computing Resources

All EE lab computers (except WCH 126) run Windows 7 with the following software installed: Atmel AVR Studio, Cadence SPB, Codewarrior IDE, Digilent Adept, Hapsim, Matlab, Microchip MPLAB C32, Microchip MPLAB IDE, Microchip PICkit 2, MS Office, MS Visual Studio, Realterm, and Xilinx ISE Design Studio.

Due to older hardware restrictions to support the ECP Model 205 Torsional Plants, WCH 126 computers run Windows XP with a smaller subset of the software mentioned above.

WCH 125 also has 5 computers installed with an NVidia Quadro 2000 graphics card. This card is used for an upper division EE Course in parallel computing. These computers include this additional software: NVidia 3D Vision, NVidia CUDA Toolkit & SDK, NVidia GPU Computing SDK, and NVidia Parallel Nsight.

WCH 121 (Instruction Lab: Available to students only during lab.)

- 16 of 19 inch LCD monitors
- 16 of Intel Core2 Duo E7200 @ 2.53 GHz w/ 4 GB RAM & 80 GB HD computers
- 16 of HP 54600B Oscilloscope
- 16 of HP 33120A Waveform Generator

- 16 of HP E3630A Power Supply
- 16 of HP 34401A Meter

WCH 125 (Instruction Lab. Available to students from 8am to 10 pm daily.)
- 30 of 21-23 inch LCD wide-screen monitors
- 16 of Intel Core i5-2400 @ 3.10 GHz w/ 3 GB RAM and 250 GB HD
- 14 of Intel Core i3-2100 @ 3.10 GHz w/ 3 GB RAM and 250 GB HD
- 5 of NVidia Quadro 2000 PCI-X graphics cards (installed in 5 lab computers).

WCH 126 (Instruction Lab: Available to students only during lab and 24/7 for senior design.)
- 16 of 17inch LCD monitors, Pentium 4 3.0GHz CPU, 512MB RAM, 40 GB HD computers
- 16 of Tektronix TDS420A Oscilloscope
- 16 of HP 33120A Waveform Generator
- 16 of Power Supply
- 16 of Fluke 45 Meter
- 12x ECP Model 205 Torsional Plants
- 9x ECP Model 205 ISA computer control cards
- 1x ECP Model 205 PCI computer control card

WCH 128 (Instruction Lab: Available to students only during lab.)
- 16 of 21inch LCD monitors
- 16 of Intel Core 2 Duo E6750 @ 2.66 GHz w/ 2 GB RAM & 80 GB HD computers
- 16 of Agilent DSO3102A Oscilloscope
- 16 of Agilent 33210A Waveform Generator
- 16 of HP E3630A Power Supply
- 16 of HP 34401A Meter

WCH 221 (Computational Lab. Available to students 24/7.)
- 16 of Dell E2011H 20-inch Widescreen LCD monitors
- 16 of Pentium D 2.80GHz CPU, 1GB RAM, 80GB Hard drive.

Additionally computing resources that support students are three NIX computational servers that are available anytime for students. These computational servers have the following programs installed for instructional support: Mathematica 8, Matlab, Cadence IC 5141, Cadence IC 610, Sentaurus TCAD, Agilent ADS, Agilent EMPRO, Agilent ICCAP, and Synopsys HSPICE.

All labs have wired Ethernet to the lab computers and wireless internet for students' personal computers.

7.3 Guidance

The students receive guidance on lab safety and the standard lab equipment usage, with equipment orientation documents and help from the TA, in the lab associated with the first circuits course EE001A. Officially, this lab course is listed separately as EE001AL. For special purpose equipment or tools, the EE Shop provides instruction on proper operation and hands-on support.

In addition the IEEE student branch, under the guidance of the EE Senior Electronic Technician, offers workshops on beginner and advanced circuit prototyping.

The students receive guidance of computing resources from the lab manuals. They also sign a computer usage agreement when they get their BCOE computer account.

Safety in EE
Lab and electrical safety is addressed in the lab manuals for each of the following courses: EE001LA, EE001B, EE100A, EE100B, EE120A. In each of these courses, Lab 0 covers the basics of the test equipment operation and the safety precautions that must be observed during such operation. The course teaching assistant (TA) is responsible for making sure that the safety guidelines are followed. The TA is informed of this responsibility during TA orientation at the beginning of the quarter. Additional safety precautions are introduced in the lab manuals, as they are needed. These precautions vary from good circuit assembly practice guidelines to mistakes that should be avoided and the possible dangers of not avoiding such mistakes.

7.4 Maintenance and Upgrading of Facilities
We maintain a schedule of approximate dates for lab computer equipment upgrades. Upgraded hardware must meet the minimum specifications for the courses/labs taught, software requirements, and hardware interaction. Software upgrades must work with the current labs being taught. Additionally, computers must meet the minimum hardware requirements as required by the software. Both hardware and software upgrades are done in a non-disruptive process. This usually occurs during summer before the beginning of the fall quarter.

The electrical instrumentation in the labs is repaired or replaced as required. The EE Shop maintains an inventory of a few extra of each item so that breakage of equipment does not affect lab instruction.

Computers are viewed as having a three-year usable lifetime. The nominal plan is that each year the computers in WCH 125 are replaced with new computers. The computers from WCH 125 (now one year old) are shifted to one of the other labs. By this method, the newest computers are in the lab where they are most needed and none of the labs have computers more than three years old. The control systems lab is exempt from this process, as the lab equipment requires a PC architecture that is not available with modern computers.

The most recent teaching lab upgrades are summarized as follows:
- WCH 125 – Computers and monitors were upgraded in 2011.
- WCH 128 – Computers and monitors were upgraded in 2011.
- WCH 221 – Computers and monitors were upgraded in 2011.

7.5 Library Services
Library collections that support the Bourns College of Engineering are housed in the Orbach Science Library. The Orbach Science Library has a seating capacity of 1,500 including individual carrels, study tables and 25 group study rooms. The library makes available 79 computer workstations for students to use in their research and study, and another 32 computers to support information literacy instruction. The entire UCR library system provides both wired and wireless

access to the internet for student laptop use, and laptops are available for check-out at the Circulation Desk. *Online access to IEEE Explore, and many other journals, (94,770 titles in all) is available from any computer on campus or remotely through VPN access.* Articles unavailable through immediate online access can be requested via e-mail and are delivered electronically within a few days.

Normal library hours during the regular school year are as follows:

Monday-Thursday	7:30am – 11pm
Friday	7:30am to 5:00pm
Saturday	Noon to 5:00pm
Sunday	1:00pm to11:00pm.

The Orbach Science Library maintains a professional staff of eight librarians, all of whom provide reference and research assistance to engineering students, faculty, and staff. Of these librarians, one is assigned subject responsibility for engineering and is available to assist students, faculty and staff with in depth research questions. The Engineering Librarian and Subject Specialist also offers tutorials and classes on engineering information topics, and maintains Web pages and path-finders to assist engineering students, faculty, and staff in locating the information they need.

The UCR Libraries offer a full range of reference services, including walk-up, telephone, and 24/7 e-mail reference services (Ask A Librarian) through a UC-wide and national network as well as reference by appointment. The Orbach Science Library reference desk is staffed 52 hours per week during the academic year (9am-8pm. Monday-Thursday, 9am-5pm on Friday) and 40 hours per week during inter-session periods. In addition to these standard services, engineering students can receive additional reference help from other reference librarians who are assigned to the Science Information Services desk. The Engineering Librarian is available for extended consultation on Senior Design or other research projects.

Incoming freshman typically receive library orientation sessions in their introductory classes. They also have additional information in classes that require independent research, such as senior design classes. One-on-one or group tutorials are available for any research topic that might be desired and helpful to engineering students.

7.5.1 Library Collections

Books

Engineering books are acquired as part of the Orbach Science Library's purchasing profile, ordered from catalogs or suggested by students, faculty, and staff. Within the past three years, the library has initiated the purchase of engineering e-books and currently supports and maintains a collection of thousands of electronic books in the EE discipline. The Libraries provides licensed access to all of the current Springer books online, many of the e-books from the CRC EngNetBase, the Knovel Collection, the Wiley Online collection and many more.

Journals

The Libraries currently subscribe to 121 engineering print journals. UCR students, faculty, and staff have access to a vast collection of online journals (94,770 unique titles). UCR maintains access, for example, to all of the journals and proceedings of IEEE, OSA, MRS, and ACM, as well as either proceedings or journals from many other societies. Faculty, staff, and students may suggest new books, journals or other media to be purchased by the library. Library users may request materials that are not available on campus through Interlibrary Loans, and the materials will be made available to them at no cost in a very reasonable amount of time.

Research (Journal Article) Databases
UC Riverside engineering students have access to a number of journal databases to assist them in their research in engineering and in other areas of study. Through co-investments with the other eight UC campuses and the California Digital Library (CDL) Inspec, Compendex, and the Web of Science as well as SciFinder Scholar for chemistry and chemical engineering and Biosis or MEDLINE for biotechnological literature are all available to engineering faculty and students.

Table 7-2 summarizes key data about the UCR Libraries.

7.6 Overall Comments on Facilities

BCOE follows the University of California Policy on Management of Health, Safety and the Environment and partners closely with UCR's Office of Environmental Health & Safety, UC Police Department, and UCR Office of Risk Management, and systemwide laboratory best practices to ensure student, faculty, and staff safety while also protecting the environment and BCOE resources.

Each BCOE department has assigned a Laboratory Safety Officer (LSO). The LSOs assist with class lab operations and equipment management, with their departments with development and implementation of the department Chemical Hygiene Plan, and perform periodic laboratory safety audits (at least annually). BCOE LSOs meeting monthly to discuss strategy, share lessons learned, and ensure safety in learning and research.

Table 7-2. Data about the UCR Libraries pertinent to the Bourns College of Engineering.

LIBRARY COLLECTIONS

	Books	Periodicals
Entire Institutional Library	2,810,229: (Print Vols.) 404,191: (e-Books) Total Vols.: 3,214,420	6,329 (Active Local Titles)
Engineering and Computer Science	71,757 Print / 29305	168 print / 3976 online

LIBRARY EXPENDITURES (See Table Explanations below)

	2008-2009	2009-2010	2010-2011
Expenditures for Engineering (Total)	$75,749	$75,107	$45,975
Print Books	$13,264	$11,824	$9,629
*Local Costs Only for Engineering Periodicals Subscriptions	$47,589	$47,706	**$21,163
E-Book Packages (EngNetbase, O'Reilly)	$7,043	$7,332	$6,483
***Research Databases	$15,185	$14,741	$15,957

* This figure does not include the total amount ($2.4 million) expended annually by the UCR Libraries as co-investments with other UC campuses and the California Digital Library (CDL) to support access to e-journals, e-books, and electronic databases. The value of the e-journals for supporting engineering alone is over a million dollars annually.

** This figure reflects a major journal cancellation. The cancelled subscription included duplicate and low use titles especially targeting print titles that duplicated e-journal titles. This was a UCR project in response to budget reductions.

*** Cost for Compendex and Inspec databases. Other databases such as SciFinder, Water Resources Abstracts, Web of Science support multiple disciplines, in addition to Engineering.

CRITERION 8. INSTITUTIONAL SUPPORT

8.1 Leadership

The EE Department is led by the EE Chair and supported by full time department staff as discussed in Section 8.C. The Chair has responsibility for organizing the faculty to ensure the quality, integrity, and continuity of the EE degree program. The Chair appoints a faculty member to be the EE Undergraduate Advisor and a representative set of faculty to serve as the undergraduate committee. The history of EE Chairs and UG Advisors is shown in Table BG-2.

The UG Advisor leads the UG committee and has responsibility for overseeing course content, catalog course descriptions, new course approvals and redesign or removal of obsolete courses. The UG advisor attends BCOE UG committee meetings and is the lead EE person in interactions with the staff in the BCOE Student Affairs Office. The EE Chair and UG Advisor discuss each year's course offerings and teaching assignments. The Chair has the responsibility for the final decisions.

The EE Chair and UG Advisor discuss issues, ideas, and plans frequently. This is one of the highest bandwidth feedback loops. Students, faculty, the Dean's office or Student Affairs may contact either the Chair or Advisor. The subsequent discussions funnel these issues into either short-term fixes or longer-term projects. Longer-term projects, such as redefinition of courses or program structure, are vetted through the UG committee and brought to the EE faculty meeting for discussion. Depending on the project, it may also be brought before the BCOE Executive Committee or the EE Board of Advisors. These feedback loops are presented in Figures 4.2 and 4.3.

The course offerings determine the EE TA and grader requirements. The TA and grader assignments to meet those requirements are the responsibility of the EE Graduate Advisor who works with the EE Graduate Student Affairs Officer and the faculty teaching each course.

This organizational structure is working well.

8.2 Program Budget and Financial Support

8.2.1 Resources Provided to the Program

EE program resources are received in various forms:

- EE receives income from a few sources: enrollment of students through the University Extension, course materials fees, and gifts.
- BCOE provides funds to the EE department for staff, part-time student assistants, teaching assistants, readers, graders, materials and supplies, and program administration personnel.
- BCOE provides funds for the academic year faculty salaries.

- BCOE provides instructional equipment funds on an annual basis, usually in the Spring, in response to requests from the departments.
- BCOE maintains an office of UG Student Advisors who interact with program students, monitor academic progress, enable registration, and direct them to appropriate services on campus for tutoring, career counseling, etc.
- BCOE has developed and directly funds a Professional Milestones Program to enable students to prepare for internships, job interviews, and research opportunities (see Fig. 1.4).
- UCR provides tutoring service at the Learning Center and in the student dormitories (free for students living on campus).
- UCR provides graduate student and TA development programs through the Graduate Division.

8.2.2 Budgeting

The University of California, Riverside has a multi-step budget development process. The major steps in the annual process are:

February:	Campus Budget Call Letter is distributed and meetings held with academic units to discuss faculty renewal models
March:	Comprehensive Planning Documents are submitted to the Executive Vice Chancellor
April:	Individual unit hearings with senior UCR management
May:	Input and feedback from Faculty Senate Committee on Planning and Budget to EVC
June:	Final unit budgets announced

All BCOE academic programs receive Permanent University funding for tenure track faculty, program staff, materials and supplies and travel. Table 8-1 summarizes Permanent University funding allocations to BCOE departments over the last five fiscal years.

Table 8-1. History of the Bourns College of Engineering permanent budget by degree program.

College of Engineering 5-year PERM Budget History					
PERMANENT BUDGET	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
Bioengineering	1,058,145	1,227,145	1,234,245	1,396,905	1,518,223
Chemical Engineering	1,123,049	1,162,226	1,180,026	914,226	944,701
Environmental Engineering	1,123,049	1,162,226	1,180,026	914,226	944,701
Computer Science	2,665,015	2,759,768	2,739,142	2,747,073	2,649,119
Electrical Engineering	2,122,786	2,249,370	2,285,339	2,144,774	2,297,533
Computer Engineering	1,196,950	1,252,284	1,256,120	1,222,848	1,236,663
Mechanical Engineering	1,787,872	1,874,172	1,861,691	1,831,767	1,859,708
Materials Science & Engr.	31,018	40,058	40,058	85,452	85,452
Grand Totals >	**11,107,884**	**11,727,248**	**11,776,646**	**11,257,270**	**11,536,099**

In addition, BCOE academic departments receive Temporary University funding each fiscal year for lecturers, teaching assistants, instructional equipment, etc. The amounts of these annual allocations over the last five fiscal years can be found in Table 8-2. (Note: FY 11/12 allocations for Instructional Equipment will be made at the end of the fiscal year).

Table 8-2. Temporary funding per degree program.

College of Engineering 5-year TEMP Funding Summary							
TEMP Funding		2007-08	2008-09	2009-10	2010-11	2011-12	Totals
Bioengineering							
	Lecturers	0	0	0	3,022	0	3,022
	Teaching Asst/Grd Stdnts	25,608	108,305	68,665	138,785	193,129	534,492
	Instructional Equipment	5,000	20,000	46,470	0	0	71,470
	Other	26,683	44,190	71,724	91,781	39,498	273,876
	Totals >	57,291	172,495	186,859	233,588	232,627	882,860
Chemical Engineering							
	Lecturers	57,278	57,000	47,984	63,815	55,078	281,155
	Teaching Asst/Grd Stdnts	104,680	111,477	104,659	124,318	114,733	559,867
	Instructional Equipment	19,000	13,500	20,000	13,000	0	65,500
	Other	20,845	32,660	76,563	45,783	21,065	196,915
	Totals >	201,803	214,637	249,205	246,916	190,876	1,103,436
Environmental Engineering							
	Lecturers	57,278	57,000	47,984	63,815	55,078	281,155
	Teaching Asst/Grd Stdnts	104,680	111,477	104,659	124,318	114,733	559,867
	Instructional Equipment	19,000	13,500	20,000	13,000	0	65,500
	Other	20,845	32,660	76,563	45,783	21,065	196,915
	Totals >	201,803	214,637	249,205	246,916	190,876	1,103,436
Computer Science							
	Lecturers	191,271	202,562	225,179	238,845	222,222	1,080,079
	Teaching Asst/Grd Stdnts	705,498	759,944	684,066	639,820	684,945	3,474,274
	Instructional Equipment	38,966	35,449	20,000	21,486	0	115,901
	Other	77,283	78,908	68,020	88,449	47,647	360,307
	Totals >	1,013,018	1,076,863	997,265	988,600	954,814	5,030,560
Electrical Engineering							
	Lecturers	65,875	51,850	46,018	102,119	74,275	340,137
	Teaching Asst/Grd Stdnts	321,434	313,379	270,354	274,592	288,312	1,468,071
	Instructional Equipment	30,756	32,000	58,394	22,135	0	143,285
	Other	47,067	57,586	61,998	50,162	91,260	308,073
	Totals >	465,132	454,814	436,764	449,009	453,847	2,259,566
Computer Engineering							
	Lecturers	64,286	63,604	67,800	85,241	74,124	355,055
	Teaching Asst/Grd Stdnts	256,733	268,331	238,604	228,603	243,314	1,235,585
	Instructional Equipment	17,430	16,862	19,598	10,906	0	64,796
	Other	31,088	34,124	32,505	34,653	34,727	167,097
	Totals >	369,538	382,921	358,507	359,403	352,165	1,822,533
Mechanical Engineering							
	Lecturers	81,501	60,282	47,724	83,217	59,625	332,348
	Teaching Asst/Grd Stdnts	308,637	306,214	324,148	315,198	366,875	1,621,072
	Instructional Equipment	84,306	36,632	46,000	31,254	0	198,191
	Other	83,077	73,636	75,742	68,461	42,120	343,036
	Totals >	557,520	476,764	493,614	498,130	468,620	2,494,648
Materials Science & Engineering							
	Lecturers	0	0	6,500	12,000	12,000	30,500
	Teaching Asst/Grd Stdnts	1,000	0	12,000	18,000	18,887	49,887
	Instructional Equipment	0	0	0	0	3,201	3,201
	Other	15,880	9,947	11,732	23,572	17,723	78,854
	Totals >	16,880	9,947	30,232	53,572	51,811	162,441
	Grand Totals >	2,882,985	3,003,078	3,001,651	3,076,133	2,895,636	14,859,482

As detailed in the table above, each BCOE academic program receives annual Temporary University funding allocations for teaching assistants and graders. Each program allocates these resources independently but in general, each lab section is supported by a 25% time TA.

Details of BCOE offices, classrooms and Laboratories can be found in Criterion 7.

BCOE budgets approximately $300,000/year for instructional equipment acquisition and upgrades. These funds are allocated to BCOE academic programs on an annual request basis. The instructional equipment dedicated to the electrical engineering degree program over the past three fiscal years is listed below:

Electrical Engineering
Instructional Clean Room (for EE 136)
Lab Equipment for WCH 126:
  Digital multimeters and power supplies
  Replacement PCs and monitors
  Oscilloscopes
  Function Generators
  Metal Lab Stools
  New Server
  HP Laserjet P4015n networkable printer
  FPGA Evaluation boards
Computers and monitors for WCH 121

In addition, most BCOE undergraduate lab courses charge a Course Materials Fee of $20 to $50 per student. Per UCR policy, these fees can only be used to purchase expendable laboratory materials and supplies including chemicals, glassware, software, computers, etc. For FY 10/11, approximately $210,000 was generated in Course Materials Fees by BCOE academic programs.

From its various sources, the EE Department has the resources to provide and maintain the equipment and services necessary for the students to achieve the desired outcomes.

8.3. **Staffing**
The total headcount of administrative, instructional and technical staff in BCOE for FY 11/12 can be found in Appendix D2.

The following is the list of staff and their responsibilities in the EE program. All staff listed below are full-time.

Bill Bingham, Financial & Administrative Officer III
Overall management of the Department of Electrical Engineering, Center for Research in Intelligent Systems and UC-Light

Danny Haughton, Programmer/Analyst IV
IT Manager/Computer Systems Administrator for the Department of Electrical Engineering, Center for Research in Intelligent Systems and UC-Light. Also serves as backup to the BCOE Computer Systems Administrator

Trudi Loder, Analyst I
Financial and administrative duties for the Department of Electrical Engineering, Center for Research in Intelligent Systems and UC-Light

Elmar Palma, Associate Development Engineer
Provides technical support for instructional labs; Lab Safety Officer for the Department of Electrical Engineering, Center for Research in Intelligent Systems and UC-Light

Adrienne Thomas, Student Affairs Officer I
Instructional program administration for the Department of Electrical Engineering

The BCOE Dean's Office provides the following centralized services: undergraduate student affairs and advising; contract/grant pre-award processing and academic personnel. All other administrative functions (purchasing, payroll, grad student support, etc.) are provided at the departmental level. Over the past five fiscal years (2005/2006 – 2010/2011), the number of BCOE administrative and technical staff has decreased by 8.75 FTE, from 131.75 to 123 due to UCR budget reductions. However, all but 0.25 FTE of these positions have occurred in central Dean's Office operations and were accomplished with little direct impact on BCOE's academic programs.

During each fiscal year, BCOE administrative and technical staff salaries are compared with salaries of similar positions within BCOE and within other UCR academic and administrative units. Any significant salary lags are addressed through UCR's staff equity and reclassification process. During the past two fiscal years, 10-11 staff reclassifications or equity adjustments were processed per year. This process has helped to reward and retain experienced BCOE staff. In 10/11 Danny Haughton received a reclassification. In 11/12, Bill Bingham and Elmar Palma received equity increases. In 11/12 Adrienne Thomas earned an award for EE Employee of the Year.

In addition to offering on-line and in-class training required to perform a staff position's basic responsibilities (i.e., payroll, purchasing, etc.), UCR offers extensive career development training programs including:

- Certificate programs in Building Core Competencies, Diversity Training, Performance Management, Professional Academic Advising, Professional Graduate Student Advising and Work Leadership
- Emerging Leader (mentorship) Program
- Management Skills Assessment Program

Most of the above training is at no cost to the employee. All required and optional training is offered through UCR's Human Resource's Learning Center. The completion of employee's required and optional training is recorded in UCR's automated Learning Management System (LMS).

8.4. Faculty Hiring and Retention

8.4.1 Faculty Recruitment Process

BCOE is still growing toward its target size of approximately 120 faculty members, so, even despite budget pressures, faculty recruitment is an annual event. The basic faculty hiring process is as follows:

1. Each year, departments are asked to submit a faculty recruitment plan that is consistent with their strategic plan.
2. The recruitment plan is sent to the Dean for his review.
3. The Dean then outlines a collective recruitment plan for the College and requests ladder-rank faculty lines from the Provost.
4. The Provost makes an allocation of ladder-rank faculty lines to the College and the Dean determines the overall priorities for the College.
5. The Dean lets the departments know if they can begin a search for faculty members and, if so, how many.
6. The department then forms a faculty committee to prepare a detailed recruitment plan for the position(s). The detailed recruitment plan includes a listing of the search committee, written ads and where they will be placed, flyers for distribution at professional conferences, letter templates for bulk mailings to other relevant departments, an affirmative action plan, and a deadline for priority recruitment.
7. Those detailed plans are sent to the Dean, Provost, and Affirmative Action offices for approval.
8. Once approved, ads are placed, mailings are sent, and the College on-line recruitment website is opened. All applications are received through the College recruitment website.
9. All applications received by the priority deadline are reviewed by the faculty search committee. The committee assesses how well the applicants meet the goals of the department and their potential as a faculty colleague.
10. An initial short-list is developed, then further refined until a list of interviewees is developed.
11. Once the list of interviewees is developed, the list is shared with the department at large, the Dean, and the Affirmative Action office. The Affirmative Action office requires reasons for why candidates were not considered for further consideration.
12. Once the department, Dean, and Affirmative Action Office approve the list, the candidates are invited to campus for an interview where they give one or two seminars, meet with department and other potentially relevant faculty, and the dean.
13. Following the interviews, the department recommends one or more candidates to the Dean for approval to make an offer of appointment. Upon his approval, the candidates are informed of the offer.
14. The offer is contingent upon approval through the campus policies (Academic Personnel Manual and the Call) for faculty appointments. Procedures differ depending on level of appointment.
15. Once a formal offer is signed and approved by the Chancellor, the candidate becomes a faculty member in the department.

In 07/08, EE hired Elaine Haberer and Anastasios Mourikis. In 2010/2011, EE hired two new faculty: Qi Zhu and Wei Ren. In 2011/2012, EE hired Hamed Mohsenian-Rad.

8.4.2 Faculty Retention

The primary strategy is to maintain an atmosphere conducive to achieving excellence in all that we do. We strive to recognize excellent performance in teaching, research and service. We provide sufficient resources for the faculty to advance their research: initial complement funds, laboratory space, and assigned students. Annual training is provided for improving teaching methods. The faculty is encouraged to take online training on a regular basis in topic areas such as Health and Safety, Information Security, Leadership, Effective Use of Advanced Technology in the Classroom, etc. They are given assignments to college and campus committees to provide service and growth of responsibilities.

The UC step system is designed to encourage, recognize and reward productive faculty. At the Assistant Professor rank there are seven steps with a nominal time of two years per step. At the Associate Professor rank there are five steps with a nominal time of two years per step. At the Professor rank there are ten steps with a nominal time of three years per step. The step system ensures faculty peer and administrative evaluation at known regular intervals, with merit advances earned for productivity. BCOE works to accelerate promotion opportunities for outstanding performance. Junior faculty are provided with mentoring by senior faculty members and provided opportunities for them to mentor students.

The UCR BCOE strives to ensure that our faculty to be of the highest quality. This makes them attractive to other engineering schools. If, as a result, a faculty member receives an offer from another institution, BCOE may provide a matching offer to attempt to retain the individual. These strategies and actions are predominately successful.

8.5. Support of Faculty Professional Development

Faculty professional development funds are provided to assistant professors as part of their faculty start-up packages. In addition, the Academic Senate provides travel assistance grants, and the campus provides grants to support innovative teaching. Also, funds are available to all faculty from their faculty support accounts, which are funded by a number of activities including a (small) portion of indirect costs generated by grants and contracts.

The University offers leaves of absence with pay to attend professional meetings or other University business in addition to its normal sabbatical leave program in order to maintain faculty currency. The University also offers other types of leave with or without pay that may extend over a longer period of time, for good cause. The University Leave policies are covered in section V. (Benefits and Privileges) of the Academic Personnel Manual (APM).

The College provides funds to cover the cost of the faculty member’s replacement while on leave. Faculty are also given latitude to modify class schedules/exams to some extent when necessary to accommodate specific professional development needs that require short or intermittent absences during the academic year. In some cases, other department faculty assist with covering a particular class or exam.

PROGRAM CRITERIA

The EE Program covers all the requirements of the Program Criteria. These have been discussed in detail under Criterion 5. Table 5-3 lists all the courses in the various categories – breadth requirements, math/sciences, core and electives. The EE Course Plan, provided earlier in Fig. 5-1, provides a sample study plan that ensures graduation within four years and meeting all the prerequisites (Table 5-2). The technical electives (see Fig. 5-1 (b)) provide a broad range of options from which the students can choose based on their interests.

Appendix A: Syllabi

EE 001A: ENGINEERING CIRCUITS ANALYSIS I

Credits and Contact Hours
4.0 Units
Lecture: TR 2.10 pm – 3.30pm; BRNHL B118
Laboratory:

Sect 002	M	11:10 a.m. - 02:00 p.m.	CHUNG 121
Sect 003	M	02.10 p.m. – 05:00 p.m.	CHUNG 121
Sect 004	T	08:10 a.m. - 11:00 a.m.	CHUNG 121
Sect 006	T	06:10 p.m. - 09:00 p.m.	CHUNG 121
Sect 007	W	11:10 a.m. - 02:00 p.m.	CHUNG 121
Sect 008	W	02.10 p.m. – 05:00 p.m.	CHUNG 121
Sect 009	W	06:10 p.m. - 09:00 p.m.	CHUNG 121
Sect 011	R	11:10 a.m. - 02:00 p.m.	CHUNG 121
Sect 012	R	06:10 p.m. - 09:00 p.m.	CHUNG 121
Sect 014	F	02.10 p.m. – 05:00 p.m.	CHUNG 121

Instructor and TA
Roman Chomko, Lecturer, Dept. of Electrical Engineering;
WCH 411
TA: Yuan Tian (Sections 6, 9), WCH 109; Armen Gholian (Sections 3, 7), WCH 109; Muhammad Morshed (Sections 8, 11), WCH 109; Hui Zhao (Section 14), WCH 109

Textbooks and Related Materials

1. (Text) Charles Alexander, Albert Matthew Sadiku, "Fundamentals of Electric Circuits", 5th ed., McGraw-Hill
2. (Text) J. W. Nilsson and S. A. Riedel, "Introduction to PSpice Manual for Electric Circuits", Prentice Hall, 2000

Specific Course Information

A. Course Description (Catalog description)
Ohm's law and Kirchoff's laws; nodal and loop analysis; analysis of linear circuits; network theorems; transients in RLC circuits. Application of Spice to circuit analysis.

B. Prerequisite(s)
MATH 046, PHYS 040C (both may be taken concurrently); concurrent enrollment in EE 01LA.
C. Course Type
Electrical Engineering, required.
Specific Goals
A. Course Objectives
1. Introduction: overview, basic concepts, circuit elements, Ohm's law, Kirchhoff's law.
2. Resistive Circuit: series connection, parallel connection, bridge circuit.

3. Methods of Circuit Analysis: node-branches, node-voltage method, mesh-current (or “loop-current”) method, equivalent circuits, maximum power transfer, source transformation, superposition principle.
4. Operational Amplifiers: op-amp terminals, terminal voltage and current, inverting and non-inverting amplifier circuits, summing and difference circuit.
5. Capacitors and Inductors: characteristics of capacitors and inductors, interconnections of capacitors and inductors.
6. RLC Circuits: RC, RL, and RLC circuits, natural and step responses, and their solution and analysis.

B. Student Outcomes Addressed

Item	COURSE OBJECTIVES	OUTCOMES										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Know and be able to use the definition of generators (sources of electric power), voltage, current, energy											
2	Understand the operation and voltage-current relationships for resistors, dependent and independent generators, inductors, capacitors											
3	Understand miscellaneous reference voltage and current assignments for circuit analysis	1										
4	Understand Kirchhoff’s Voltage and Current Laws	1										
5	Understand the origin and be able to apply various circuit analysis techniques such as (E)NBM (node-branches method), (E)NVM (node voltage method) and LCM (loop current method)	1										
6	Be able to apply equivalent transformations such equivalent resistances (both fundamental and special), Thevenin’s equivalent circuits, source transformations and other network theorems	1		1		1					1	
7	Understand the operation of simple sensor circuits such as a bridge circuit		1	1								
8	Understand the operation of OpAmps both Ideal and Practical and their application for analog computers	1		1								
9	Understanding of intrinsic properties (voltage/current characteristics) of capacitors and inductors											
10	Be able to derive transient step responses of RL, RC, RLC circuits											

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE 001B: ENGINEERING CIRCUITS ANALYSIS II

Credits and Contact Hours

4.0 Units
Lecture: MWF 3.10 pm – 4.00pm; ENGR2 141
Laboratory: W 8.10 am – 11.00 am, ENGR2 128

Instructor and TA

Roman Chomko, Lecturer, Dept. of Electrical Engineering;
WCH 411
TA: Qian Gao, WCH 109

Textbooks and Related Materials

1. (Text) R. Dorf, J. Svoboda, "Introduction to Electric Circuits", 8th ed, Wiley, 2010
2. (Reference) J. W. Nilsson & S. A. Riedel, "Electric Circuits", 8th ed., Prentice-Hall, 2007

Specific Course Information

A. Course Description (Catalog description)

Sinusoidal steady state analysis, polyphase circuits, magnetically coupled networks, frequency characteristics, Laplace and Fourier transforms, Laplace and Fourier analysis. Application of SPICE to complicated circuit analysis.

B. Prerequisite(s)

EE 001A

C. Course Type

Electrical Engineering, required.

Specific Goals

A. Course Objectives

The objective of this course is to develop students' ability to analyze and design RLC alternative current electronic circuits, fundamental power electronics circuits including 3-phase power circuits, and analog filters. Development of basic EE1A skills of node-voltage and mesh-current circuit analysis in frequency domain by the application of phasor, and Fourier and Laplace transforms is another critical objective.

B. Student Outcomes Addressed

Item	COURSE OBJECTIVES	OUTCOMES										
		A	B	C	D	E	F	G	H	I	J	K
1	Know and be able to use phasors for solution of circuits in steady-state problems	1										
2	Understand the steady-state power: instantaneous power, average power, reactive power, complex power	1	1			1						
3	Understand wye-delta, delta-wye impedance transformations	1	1			1						
4	Understand the Laplace Transform and Inverse Laplace Transform and how to apply the Laplace Transform properties to simplify the Laplace Transform calculations	1	1									
5	Representation of circuits in frequency domain	1	1									
6	Know how to apply Network Theorems (equivalent circuits, Thevenin Transform, etc.) to simplify solution of circuit problems	1	1						1			
7	Knowledge of how to perform partial fraction expansion	1										
8	Know how to compute transfer functions and how to represent them diagrammatically using Bode Plots and Asymptotic Bode Plots	1	1			1						
9	Knowledge of basic filters: low-pass, high-pass, band-pass, band-reject, both passive and active	1	1			1						

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE 10 Introduction to Electrical Engineering

Credits and Contact Hours
1.0 Unit
Lecture: One hour lecture weekly

Grading: Satisfactory/No Credit. Based on attendance and participation in class and in activities.

Textbook and Related Materials
No textbook.

Specific Course Information

A. Course Description (Catalog description)
Introduces electrical engineering applications, career options and the electrical engineering curriculum. Provides motivation and context for the two years of mathematics and science courses that are prerequisites to most EE courses. Discusses contemporary engineering issues, social and environmental impact of engineering solutions, professional ethics and need for life-long learning.

B. Prerequisite(s)
None

C. Course Type
Electrical Engineering, required.

Specific Objectives

A. Course Objectives
1. Students gain a broad perspective of the EE field and profession.
2. Students gain an understanding of a broad range of EE applications and the required the math and science background.
3. Students understand the EE academic program at UCR.
4. Students gain opportunities to know and interact with EE faculty and alumni.
5. Students gain an understanding of the impact of engineering solutions in a global, economic, environmental, and societal context.
6. Students gain an understanding of contemporary engineering issues in several fields of EE.
7. Students gain understanding of professional and ethical responsibility.
8. Students recognize the fast-changing nature of EE and the need for life-long learning.

List of Topics
This course will be led by the department chair and undergraduate advisor, and team taught by EE faculty with guest talks by EE alumni or local engineers, to give students a

broad perspectives of the EE field and profession, an understanding of the academic program and opportunities to interact with EE faculty and alumni. To reinforce the lectures, student will be assigned activities that may include reading assignments, involvement with professional societies and clubs, group discussions, team building, and career guidance.

Weekly Lectures

1. Welcome (Dept. Chair and Undergraduate Advisor)
    a. EE Career Options
    b. EE Salary and employment statistics
    c. Nationwide EE Retention Issues
    d. Objectives of the course
    e. EE Program Overview
2. Student professional clubs (Student Affairs Office Professional Development Officer) IEEE Workshops (EE Lab Manager and IEEE student leaders).
3. Autonomy and related Courses in Sequence, societal/environmental/economic impact, related contemporary engineering issues and need of life-long learning (EE faculty in the subject area)
4. Guest talk by alumni/local engineer 1 covering selected topics listed at the bottom of this page.
5. Embedded systems applications and related Courses in Sequence, societal/environmental/economic impact, related contemporary engineering issues and need of life-long learning (EE faculty in the subject area)
6. Guest talk by alumni/local engineer 2 covering selected topics listed at the bottom of this page.
7. Imaging and Video and related Courses in Sequence, societal/environmental/ economic impact, related contemporary engineering issues and need of life-long learning (EE faculty in the subject area).
8. Guest talk by alumni/local engineer 3 covering selected topics listed at the bottom of this page.
9. Materials and Devices applications and related Courses in Sequence, societal/ environmental/economic impact, related contemporary engineering issues and need of life-long learning (EE faculty in the subject area).
10. Entrepreneurialism (EE faculty and/or alumni with entrepreneurial experience) and goal setting (What do you want your resume to look like?).

<u>Guest Lecturer Topic Coverage:</u>

- Current position and recent projects
- Most important courses and skills learned at UCR, especially those that they thought unimportant while still a student.
- Career path since graduation from UCR
- Advice to self
- Industry and technology trends and contemporary issues
- Professional and ethical responsibility

EE 020: LINEAR METHODS FOR ENGINEERING ANALYSIS AND DESIGN USING MATLAB

Credits and Contact Hours
4.0 Units
Lecture: TR 6:40pm – 8:00pm, CHUNG 138
Discussion: M 10:10 – 11:00am, R 4:10 – 5:00pm and 5:10 – 6:00pm CHUNG 125

Office Hours
Instructor: T 2pm – 4pm
TA: F 10am – 12 pm

Instructor and TA
Feras Abou-Galala, Lecturer, Dept. of Electrical Engineering, WCH411
TA: Yiming Ma, WCH 109

Textbooks and Related Materials
1. (Text) Ron Larson, "*Elementary Linear Algebra*", Cengage Learning, 7th Edition
2. (Lab manual) David Hill and David Zitarelli, "*Linear Algebra labs with Matlab*", Prentice Hall, 3rd Edition.

Course Description (Catalog Description)
Introduces MATLAB programming and linear methods for circuit and system analysis and optimization. Topics include formulating circuit problems as linear systems of equation; methods for finding their solutions; phasors for AC analysis; vector and matrix representations of signals and systems; matrices computations; and linear programming for system analysis and design

Prerequisite(s)
E MATH 8B or MATH 9HA or MATH 9A or consent of instructor

Course Type
Electrical Engineering, required.

Specific Goals

A. Course Objectives

1. Introduction to linear systems of equations, row echelon forms, reduced row echelon forms.
2. Ability to independently solve linear systems of equations using Gaussian elimination, Gauss-Jordan elimination, or LU decomposition.
3. Introduction to basic complex algebra, rectangular or polar coordinates.
4. Introduction to basic programming in MATLAB. Functions, matrix manipulation, and recursions.
5. Ability to compute the inverse, determinant, and rank of a matrix.

6. Introduction to various concepts in vector spaces: inner products, norms, orthogonal sets, orthonormal sets, linear independence, basis vectors, span, row and column spaces, and null spaces.
7. Introduction to basic circuit theory, resistors, voltage and current sources, capacitors, and inductors.
8. Ability to solve linear DC circuits, and linear AC circuits in the steady state using phasors.

B. Student Outcomes Addressed

		OUTCOMES										
Item	**COURSE OBJECTIVES**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Introduction to MATLAB programming	1										
2	Methods for solving linear system of equations	1										
3	Determinants, ranks, matrix inversion, LU factorization	1										
4	Vectors spaces, subspaces, linear independence, bases, dimension, and linear transformations					1						
5	Eigenvalues and eigenvectors	1										
6	Vectors spaces, subspaces, linear independence, bases, dimension, and linear transformations	1										

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE 100A: ELECTRONIC CIRCUITS I

Credits and Contact Hours
4.0 Units
Lecture: TR, 3:40 pm – 5:00 pm, MSE 113
Lab: Friday, 5:10 pm – 8 pm, WCH 128

Instructor and TA
Alexander Korotkov, Professor, Dept. of Electrical Engineering, WCH 434
Li Wang, Teaching Assistant, WCH 109

Textbooks and Related Materials

1. (Text) Microelectronic Circuits, 6th edition, A.S. Sedra and K.C. Smith, Oxford Univ. Press
2. (Online references for OrCAD PSpice) http://www.orcad.com, http://www.orcad.com/forums/

Course Description (Catalog Description)
Covers electronic systems, linear circuits, operational amplifiers, diodes, nonlinear circuit applications, junction and metaloxide-semiconductor field-effect transistors, bipolar junction transistors, MOS and bipolar digital circuits. Laboratory experiments are performed in the subject areas and SPICE simulation is used.

Prerequisite(s)
EE001B

Course Type
Electrical Engineering, required.

A. Course Objectives

1. Explain the basic operation and characteristics of semiconductor diodes, bipolar junction transistors (BJTs), and metal-oxide-semiconductor field-effect transistors (MOSFETs).
2. Design and analyze a rectifier circuit consisting of diodes, transformer, filter, and voltage regulator.
3. Design and analyze an amplifying stage based on the BJT or MOSFET.
4. Use small-signal models of the BJT and MOSFET for circuit analysis.
5. Analyze operation of a switching circuit based on BJT or MOSFET.
6. Perform laboratory experiments with electronic circuits containing semiconductor diodes, BJTs, and MOSFETs.
7. Write reports on performed laboratory experiments.
8. Use simulation software SPICE for analysis of electronic circuits.

B. Student Outcomes Addressed

Item	COURSE OBJECTIVES	OUTCOMES										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Basic operation and characteristics of semiconductor diodes, bipolar junction transistors (BJTs), and metal-oxide-semiconductor field-effect transistors (MOSFETs).	1										
2	Design and analyze a rectifier circuit consisting of diodes, transformer, filter, and voltage regulator.	1										
3	Design and analyze an amplifying stage based on the BJT or MOSFET.	1					B					
4	Use small-signal models of the BJT and MOSFET for circuit analysis.	1										
5	Analyze operation of a switching circuit based on BJT or MOSFET.	1										
6	Perform laboratory experiments with electronic circuits containing semiconductor diodes, BJTs, and MOSFETs.	1	1									
7	Write reports on performed laboratory experiments	1	1									
8	Use simulation software SPICE for analysis of electronic circuits.		1									

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

<u>Brief List of Topics</u>
(1) signals and amplifiers; (2) diodes; (3) bipolar junction transistors; (4) MOS field effect transistors

EE 100B: ELECTRONIC CIRCUITS II

Credits and Contact Hours
4.0 Units
Lecture: TR 02:10 p.m. - 03:30 p.m. OLMH 1126
Laboratory (choose one session): M 08:10 a.m. - 11:00 a.m. ENGR2 128
F 05:10 p.m. - 08:00 p.m. ENGR2 128
Office Hours:
Instructor: TR 4-5 pm
TA: M 11am - 12 pm, F 4-5 pm

Instructor and TA
Nissim Amos, Lecturer, Departments of Electrical and Materials Science Engineering; MSE 311
TA: Issac Ruiz, WCH 371

Textbooks and Related Materials
1. (Text) Microelectronic Circuits, 6th Edition
Authors: A. S. Sedra and K. C. Smith, Oxford University
ISBN: 978-0-19-532303-0
2. (Reference) Electronics Fundamentals: Circuits, Devices, and Applications, 8th Ed.
Authors: Thomas L. Floyd. David M. Buchla
ISBN: 978-0-13-507327-8

Specific Course Information

A. Course Description (Catalog description)
Differential and multistage amplifiers, output stages and power amplifiers, frequency response, feedback, analog integrated circuits, filters, tuned amplifiers, and oscillators. Laboratory experiments are performed in the subject areas and SPICE simulation is used.

B. Prerequisite(s)
EE 100A or consent of instructor

C. Course Type
Electrical Engineering, required.

Specific Goals

A. Course Objectives
1.Introduction to basic concepts of feedback.
2.Introduction to basic concepts of frequency response.
3.Understanding the role of diodes, transistors and operational-amplifies in devices.
4.Integration of amplifiers, oscillators, and filters in practical applications.
5.Exposure to problem solving and circuit design via SPICE simulation.
6. Ability to independently solve problems in circuit design for real life applications.

B. Student Outcomes Addressed

Item	COURSE OBJECTIVES	OUTCOMES										
		A	B	C	D	E	F	G	H	I	J	K
1	Introduction to basic concepts of feedback.	1										
2	Introduction to basic concepts of frequency response.	1										
3	Understanding the role of diodes, transistors and operational-amplifies in devices.	1	1			1						
4	Integration of amplifiers, oscillators, and filters in practical applications.	1	1			1						
5	Exposure to problem solving and circuit design via SPICE simulation.	1	1									
6	Ability to independently solve problems in circuit design for real life applications.	1	1			1						1

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE 105: MODELING AND SIMULATION OF DYNAMIC SYSTEMS

Credits and Contact Hours

4.0 Units

Lecture:	MWF	8:10 – 9:00	WCH 138
Lab:	Mon.	11:10 – 2:00	ENGR II Rm 125
Lab:	Weds.	11:10 – 2:00	ENGR II Rm 125

Office Hours

Instructor: Weds. 1-2 PM, Fri. 12-1 PM, or by appointment

TA: F 9-10 AM or by request

Instructor and TA

Jay A. Farrell, Professor, Dept. of Electrical Engineering WCH 341

TA: Yiming Chen, WCH 369

Textbooks and Related Materials

The following books are on reserve at the Science Library.

1. Systems Dynamics Modeling And Simulation of Mechatronic Systems, by D. Karnopp, D. Margolis, R. C. Rosenberg, 2005, ISBN: 0471709654, 4th Ed., John Wiley & Sons Inc.
2. Mechatronic Modeling and Simulation Using Bond Graphs, Shuvra Das, CRC Press, 2009, ISBN 1420073141.

Neither will be used for homework assignment. The course is taught from my notes, which use the notation and approach of the Karnopp text. My notes, all homework, and all labs will be distributed via ILearn. The lecture will cover and explain much more than the notes, include many more examples, and give hints for exams. Skip lecture at your own peril.

Course Description (Catalog Description)

Introduction to the mathematical modeling of dynamical systems and their methods of solution. Advanced techniques and concepts for analytical modeling and study of various electrical, electronic, and electromechanical systems based upon physical laws. Emphasis on the formulation of problems via differential equations. Numerical methods for integration and matrix analysis problems. Case studies. Digital computer simulation.

Prerequisite(s)

CS 010, EE 001A, MATH 046 or consent of instructor

Course Type

Electrical Engineering, required.

Course Objectives

Development of the

1. Ability to construct ODE and TF models of physical systems
2. Ability to translate between alternative forms of system models: transfer function, ODE, state space

3. Ability to analyze and manipulate state space models using linear algebra
4. Ability to construct state space models for dynamic systems from physical principles
5. Ability to apply and interpret frequency response analysis
6. Ability to implement a numeric simulation for a physical system
7. Ability to analyze physical system dynamics using block diagram simulation
8. Ability to work in MATLAB
9. Ability to analyze, construct, and understand bond graphs and their relation to dynamic system modeling

Student Outcomes

Item	COURSE OBJECTIVES	A	B	C	D	E	F	G	H	I	J	K
1	Ability to construct ODE and TF models of physical systems	X				X						
2	Ability to translate between alternative forms of system models: transfer function, ODE, state space	X				X						
3	Ability to analyze and manipulate state space models using linear algebra	X				X						
4	Ability to construct state space models for dynamic systems from physical principles	X				X						
5	Ability to apply and interpret frequency response analysis	X				X						
6	Ability to implement a numeric simulation for a physical system	X				X						
7	Ability to analyze physical system dynamics using block diagram simulation	X				X						
8	Ability to work in MATLAB	X				X						
9	Ability to analyze, construct and understand bond graphs and their relation to dynamic system modeling.	X				X						

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE110A: CONTINUOUS-TIME SIGNALS AND SYSTEMS

Credits and Contact Hours
4.0 Units
Lecture: TR 2:10pm – 3:30pm, SPTH 1222
Lab: F 11:10am – 2:00pm, WCH 125
Office Hours:
Instructor: R 11:00am – 12:00pm
TA: F 10am – 12 pm

Instructor and TA
Feras Abou-Galala, Lecturer, Dept. of Electrical Engineering, WCH411
TA: Yang Gao, WCH 109

Textbooks and Related Materials
1. (Text) Alan V. Oppenheim and A. S. Willsky, *Signals and Systems,* 2^{nd} ed., Prentice-Hall 1997

Course Description (Catalog Description)
To provide an introduction to fundamental concepts and tools for analysis of signals and systems

Prerequisite(s)
EE001B, MATH09C, MATH046 or consent of instructor

Course Type
Electrical Engineering, required.

Course Objectives
1. Basic skills of sketching continuous-time signals and simple operations
2. Understand the meaning, purpose, and utility of continuous-time Fourier Series and Transform
3. Basic skills of performing continuous-time Fourier Transform
4. Calculate system's response via convolution
5. Understanding the basic properties of continuous-time linear time-invariant systems
6. Understanding the basic properties of continuous-time Fourier transform and how to use them to simplify analysis
7. Calculate Fourier Series and generate harmonics using MATLAB
8. Calculate Fourier Transform and perform computation using MATLAB
9. Understand and can explain the basic concepts an utilities of filters
10. Relating Communication Systems to Fourier Transform and understanding AM modulation/demodulation basics

Student Outcomes Addressed

Item	COURSE OBJECTIVES	OUTCOMES										
		A	B	C	D	E	F	G	H	I	J	K
1	Basic skills of sketching continuous-time signals	1				1						
2	Understand continuous-time Fourier Series and Transform	1				1						
3	Performing continuous-time Fourier Transform	1				1						
4	Calculate system's response via convolution	1				1						
5	Understanding the basics of continuous-time linear time-invariant systems	1				1						
6	Understand the basics of continuous-time Fourier transform to simplify analysis	1				1						
7	Calculate Fourier Series and generate harmonics using MATLAB	1				1						
8	Calculate Fourier Transform and perform computation using MATLAB	1				1						
9	Understand and explain the basic concepts and utilities of filters	1				1						
10	Relating Communication Systems to Fourier Transform and understanding AM modulation/demodulation basics	1				1						

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE110B: DISCRETE-TIME SIGNALS AND SYSTEMS

Credits and Contact Hours
4.0 Units
Lecture: TR 12:40pm – 2:00pm, MSE 103
Lab: Check classes.ucr.edu for times, CHUNG 125
Office Hours:
Instructor: TR 11:00am – 12:00pm
TA: TBA

Instructor and TA
Feras Abou-Galala, Lecturer, Dept. of Electrical Engineering, WCH411
TA: Ali Cirik, WCH 109

Textbooks and Related Materials
1. (Text) Alan V. Oppenheim and A. S. Willsky, *Signals and Systems,* 2nd ed., Prentice-Hall 1997

Course Description (Catalog Description)
As a continuation to EE110A, this course is intended to provide an introduction to fundamental concepts and tools for analysis of discrete-time signals and systems

Prerequisite(s)
EE110A or consent of instructor

Course Type
Electrical Engineering, required.

Course Objectives
1. Basic skills of sketching discrete-time signals and simple operations
2. Understand the meaning, purpose, and utility of discrete-time Fourier Series and Transform
3. Basic skills of performing discrete-time Fourier Transform
4. Understanding the connections and distinctions between continuous-time and discrete-time Fourier transform
5. Understanding the basic properties of discrete-time linear time-invariant systems
6. Understanding the basic properties of discrete-time Fourier transform
7. Understanding the meaning, purpose, and utility of Z-transform
8. Basic skills of performing Z-transforms and inverse Z-transforms
9. Understanding the basic properties of discrete-time Z-transforms
10. Understanding the concept of the Sampling theorem and aliasing

Student Outcomes Addressed
A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.

D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulat e and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

Item	COURSE OBJECTIVES	OUTCOMES										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Basic skills of sketching discrete-time signals and simple operations	1				1						
2	Understand the meaning, purpose, and utility of discrete-time Fourier Series and Transform	1				1						
3	Basic skills of performing discrete-time Fourier Transform	1				1						
4	Understanding the connections and distinctions between continuous-time and discrete-time Fourier transform	1				1						
5	Understanding the basic properties of discrete-time linear time-invariant systems	1				1						
6	Understanding the basic properties of discrete-time Fourier transform	1				1						
7	Understanding the meaning, purpose, and utility of Z-transform	1				1						
8	Basic skills of performing Z-transforms and inverse Z-transforms	1				1						
9	Understanding the basic properties of discrete-time Z-transforms	1				1						
10	Understanding the concept of the Sampling theorem and aliasing	1				1						

EE 114: PROBABILITY, RANDOM VARIABLES, AND RANDOM PROCESSES IN ELECTRICAL ENGINEERING

Credits and Contact Hours
4.0 Units
Lecture: MWF 2.10 pm – 3pm; OLMH 1208
Discussion: W 5.10 pm – 6.00 pm; OLMH 1212

Office Hours
Instructor: M 1-2pm, W 10-11am
TA: T 4-5pm, W 3-4pm

Instructor and TA
Amit K. Roy-Chowdhury, Associate Professor, Dept. of Electrical Engineering, WCH 431
TA: Shu Zhang, WCH 371

Textbooks and Related Materials
1. (Text) Roy D. Yates and David J. Goodman, "Probability and Stochastic Processes – A Friendly Introduction for Electrical and Computer Engineers", 2nd Edition, John Wiley and Sons Inc.
2. (Reference) A. Leon-Garcia, "Probability and Random Processes for Electrical Engineering", 2nd Edition, Addison Wesley Longman.

Course Description (Catalog Description)
Covers fundamentals of probability theory, random variables, and random processes with applications to Electrical and Computer Engineering. Topics include probability theory, random variables, densities, functions of random variables, expectations and moments, multivariate distributions, random processes, autocorrelation function, spectral analysis of random signals, linear systems with random inputs.

Prerequisite(s)
EE110A or consent of instructor

Course Type
Electrical Engineering, required.

Course Objectives:
1. Introduction to basic concepts of probability.
2. Introduction to basic concepts of random variables.
3. Understanding the role of probability and statistics in real life applications.
4. Applications of probability and random variables in electrical and computer engineering.
5. Introduction to multiple random variables, joint distributions, independence and correlation.
6. Introduction to random processes and their applications.

7. Ability to independently solve problems in probability, random variables and random processes.

Student Outcomes Addressed

Item	COURSE OBJECTIVES	OUTCOMES										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Introduction to basic concepts of probability	1										
2	Introduction to basic concepts of random variables	1										
3	Understanding the role of probability and statistics in real life applications	1										
4	Applications of probability and random variables in electrical and computer engineering.					1						
5	Introduction to multiple random variables, joint distributions, independence and correlation	1										
6	Introduction to random processes and their applications	1										
7	Ability to independently solve problems in probability, random variables and random processes	1				1						

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE 115: INTRODUCTION TO COMMUNICATION SYSTEMS

Credits and Contact Hours
4.0 Units
Lectures: TR 11:10 am -12:30 pm, MSE 113
Lab:R 8:10 am - 11 am ENGR2 128

Office Hours
Instructor: R 1 – 2:00pm
TA: T 4 – 6:00pm

Instructor and TA
Ilya Dumer, Professor, Dept. Of Electrical Engineering, WCH 427
TA: Yiming Ma, WCH 109

Textbooks and Related Materials
Syllabus, course materials, lab manuals, homework assignments are posted on http://www.ilearn.ucr.edu/

Textbook:

1. B.P. Lathi, Modern Digital and Analog Comm. Systems, 3rd Ed.; Oxford, 1998 (ISBN 019511009-9) or :
2. B.P. Lathi and Zhi Ding. Modern Digital and Analog Comm. Systems, 4th ed. Oxford, 2009 (ISBN 0195331451)

References:

1. Simon Haykin, Communication Systems, Wiley, 4th Edition, 2001 (ISBN 0-471-17869-1).
2. Leon W. Couch, Digital and Analog Communication Systems. Macmillan Publishing Co., 4th Edition, 1993.

Course Description (Catalog Description)
Covers spectral density and correlation, modulation theory, amplitude, frequency, phase and analog pulse modulation and demodulation techniques, signal-to-noise ratios, and system performance calculations. Laboratory experiments involve techniques of modulation and demodulation.

Prerequisites
EE 110 B

Course Type
Electrical Engineering, required.

Course Objectives
Introduction to basic techniques in continuous communication systems**.**

1. Briefly explain what are Energy and Power spectral density, Bandwidth, Amplitude modulation, Frequency modulation.

2. Plot Fourier response of a power signal. Calculate the first-null bandwidth of base band signals.
3. Design of modulators/demodulators for AM and DSB-SC signals in software and hardware.
4. Design modulators and demodulators for phase-modulated and frequency-modulated signals.
5. Learn and use MATLAB for communication systems.

<u>Student Outcomes Addressed</u>

Item	**COURSE OBJECTIVES**	**OUTCOMES**										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Briefly explain what are: Energy and Power spectral density, Bandwidth, Amplitude modulation; Frequency modulation	2				2						
2	Plot Fourier response of a power signal. Calculate the first-null bandwidth of base band signals.	2				2						
3	Design of modulators/demodulators for AM and DSB-SC signals in software and hardware.	2	2			1						
4	Design modulators and demodulators for phase-modulated and frequency-modulated signals.	2	2			1	2					
5	Learn and use MATLAB for communication systems	1	2			1						

A. Ability to apply knowledge of mathematics, science and engineering

B. Ability to design and conduct experiments, as well as, analyze and interpret data.

C. Ability to design a system, component, or process to meet desired needs.

D. Ability to function on multidisciplinary teams.

E. Ability to identify, formulate and solve engineering problems.

F. Understanding of professional and ethical responsibility.

G. Ability to communicate effectively.

H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.

I. Recognition of the need for and an ability to engage in lifelong learning.

J. Knowledge of contemporary issues.

K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE 116: ENGINEERING ELECTROMAGNETICS

Credits and Contact Hours
4.0 Units
Lecture: TR 11.10 am – 12.30pm; SPTH 1307
Discussion: Section 021, W 3.10 pm – 4.00 pm, WCH 142; Section 022, W 4.10 pm – 5.00 pm, WCH 142

Instructor and TA
Roman Chomko, Lecturer, Dept. of Electrical Engineering;
WCH 411
TA: Zhong Yan, WCH 109

Textbooks and Related Materials

3. (Text) Fawwaz T. Ulaby, "Fundamentals of Applied Electromagnetics", 6th edition, Prentice Hall, 2007

Course Description (Catalog Description)
Transmission lines, fields and field operators, electrostatic and magnetostatic fields, time-varying fields, electrodynamics, electromagnetic waves, plane waves, guided waves, and applications to engineering problems.

Prerequisite(s)
EE1B

Course Type
Electrical Engineering, required.

Course Objectives

1. Vector and Differential Analysis
2. Electrostatics, Electric Potential, Dielectrics and Applications
3. Magnetostatics and Applications
4. Magnetic Circuits, Magnetic Recording
5. Inductors and Transformers
6. Maxwell Equations
7. Electric Motors and Generators: DC and AC

Student Outcomes Addressed

Item	COURSE OBJECTIVES	OUTCOMES										
		A	B	C	D	E	F	G	H	I	J	K
1	Vector differential calculus	1										
2	Coulomb's Law, electric charges, electric field intensity, electric potential, potential energy and voltage, electric properties of materials, polarization			1							1	
3	Understanding capacitance of devices and resistances		1	1								
4	Understanding of Poisson and Laplace equation	1	1	1								
5	Understanding origin of magnetism	1	1	1								
6	Understanding Ampere's and Faraday's Law; Lentz's Principle; electromotive force (e.m.f.)	1	1	1								
7	Maxwell equation, derivation of equations	1		1								
8	Understanding of forces in electromagnetic fields	1	1									
9	Understanding of magnetic circuits, magnetic flux, magnetomotive force (m.m.f.); Design and Analysis of transformers	1	1	1							1	
10	Understanding of principle of operation of DC motors and generators	1	1	1							1	

1. Ability to apply knowledge of mathematics, science and engineering
2. Ability to design and conduct experiments, as well as, analyze and interpret data.
3. Ability to design a system, component, or process to meet desired needs.
4. Ability to function on multidisciplinary teams.
5. Ability to identify, formulate and solve engineering problems.
6. Understanding of professional and ethical responsibility.
7. Ability to communicate effectively.
8. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
9. Recognition of the need for and an ability to engage in lifelong learning.
10. Knowledge of contemporary issues.
11. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE/CS 120A: LOGIC DESIGN

Credits and Contact Hours
4.0 Units
Lecture: MW 9:40am-11:00am; Sproul Hall 2339
Lab Section 021: MW 8:10am to 11:00am; ENGR2 125
Lab Section 022: MW 6:10pm to 09:00pm; ENGR2 125

Instructor and TA
Dr. Sheldon Tan, Professor, Dept. of Electrical Engineering;
WCH 424
TA: Eric Mlinar, Armen Gholian

Textbooks and Related Materials

4. (Text) Digital Design with RTL Design, VHDL, and Verilog, 2nd Edition by Prof. Frank Vahid (Prof. Vahid will not receive any royalty from the sale of this text book)

Course Description (Catalog Description)
EE/CS120A introduces you to the exciting world of digital design. Digital circuits not only form the foundation of computers, but make possible many of the advances around us, like cell phones, video games, medical instruments, automotive systems, satellites, PDAs, music equipment, military equipment, store automation. You name it -- if it runs on electricity, it's probably got digital circuits (known as embedded systems) inside! 120A gets you up to speed on the basics; the follow-up course, 120B, teaches you to build a computer, and to build complete working embedded computing systems. EE/CS 120A and 120B are taught jointly by the EE and CS&E departments.

Prerequisite(s)
CS 061 or consent of instructor

Course Type
Electrical Engineering, required.

Course Objectives
1. Able to perform the conversion among different number systems; Familiar with baisc logic gates -- AND, OR & NOT, XOR, XNOR; Independently or work in team to build simple logic circuits using basic gates.
2. Understand Boolean algebra and basic properties of Boolean algebra; able to simplify simple Boolean functions by using the basic Boolean properties.
3. Able to design simple combinational logics using baisc gates. Able to optimize simple logic using Karnaugh maps, understand "don't care".
4. Familiar with basic sequential logic components: SR Latch, D Flip-Flop and their usage and able to analyze sequential logic circuits.
5. Understand finite state machines (FSM) concepte and work in team to do sequence circuit design based FSM and state table using D-FFs.
6. Familiar with basic combinational and sequential components used in the typical

datapath designs: Register, Adders, Shifters, Comparators; Counters, Multiplier, Arithmetic-Logic Units (ALUs), RAM. Able to do simple register-transfer level (RTL) design.

7. Understand that the design process for today's billion-transistor digital systems becomes a more programming based process than before and programming skills are important.

Student Outcomes Addressed

Item	OUTCOME-RELATED LEARNING OBJECTIVES	OUTCOMES										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Able to perform the conversion among different number systems	3	2	1	2		1	2			1	
2	Understand Boolean algebra and basic properties of Boolean algebra; able to simplify simple Boolean functions by using the basic Boolean properties.	1		1		2						
3	Able to design simple combinational logics using baisc gates. Able to optimize simple logic using Karnaugh maps, understand "don't care".	2	1	1		1						
4	Familiar with basic sequential logic components: SR Latch, D Flip-Flop and their usage and able to analyze sequential logic circuits.	1	3			2						
5	Understand finite state machines (FSM) concepte and work in team to do sequence circuit design based FSM and state table using D-FFs.	2	1	2	3		1	2				
6	Familiar with basic combinational and sequential components used in the typical datapath designs: Register, Adders, Shifters, Comparators; Counters, Multiplier, Arithmetic-Logic Units (ALUs), RAM. Able to do simple register-transfer level (RTL) design.		3	1	2		2			1	1	
7	Able to perform register-transfer level (RTL) design. Understand behavioral-level design.		2	3		1			1	1	1	
8	Understand that the design process for today's billion-transistor digital systems becomes a more programming based process than before and programming skills are important.								2	3	3	2
	SUBTOTALS	**9**	**12**	**9**	**7**	**6**	**4**	**4**	**3**	**5**	**6**	**2**

Objectives Addresses Outcome: SLIGHTLY – 1, MODERATELY – 2
SUBSTANTIALY – 3

EE/CS120B: INTRODUCTION TO EMBEDDED SYSTEMS

Lecture: 3 hours; **Laboratory**: 6 hours

Prerequisite(s): Prerequisite(s): CS 120A/EE 120A.

Instructor: In the last five years, the following instructors have taught this class: Frank Vahid, Philip Brisk, Scott Sirowy, and Harry Hsieh.

Textbook(s):

- The C Programming Language, 2nd Edition, Kernighan and Ritchie, Prentice Hall, ISBN: 0-13-1103628

Course Objectives with Mapping to Student Outcomes:

Objective Outcome Matrix													
Objective Addresses Outcome: 1-slightly 2-moderately 3-substantially													
Outcome Related Learning Objectives	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
Understand chip technology trends Moore's law the nature of embedded computing the need to balance competing design factors and the growing productivity gap.	3	0	0	0	0	0	0	0	3	3	0	0	2
Calculate estimated time and cost impacts of various design decisions	3	0	0	0	1	0	0	0	3	3	0	0	1
Describe system behavior as a state machine and design a controller digital circuit implementation.	3	0	0	0	0	0	0	0	3	3	0	0	0
Describe system behavior as extended state machines and design a custom processor (controller and data path) implementation.	3	0	0	0	0	0	0	0	3	3	0	0	0
Describe system behavior as a sequential algorithm and design a custom processor implementation	3	0	0	0	0	0	0	0	3	3	0	0	0
Understand basic pipelining and hazards	1	0	0	0	0	0	0	0	3	1	0	0	0
Design a basic but working instruction-set processor	3	0	0	0	0	0	0	0	3	3	0	0	0
Understand assembly language and write simple assemblylevel programs.	1	0	0	0	0	0	0	0	3	1	0	0	0
Understand the function design and use of common peripherals: timers UART PWM A2D D2A converters.	2	0	0	0	0	0	0	0	3	2	0	0	0
Convert a problem description into a set of about 50-100 computer instructions	1	0	0	0	0	0	0	0	3	1	0	0	0
Understand communication methods including I/O schemes interrupts direct-memory access and arbitration	1	0	0	0	0	0	0	0	3	1	0	0	0
Draw timing diagrams to represent communication	1	1	1	0	0	0	0	0	3	1	1	0	0
Understand hardware/software trade-off through examples.	1	1	1	0	0	0	0	0	3	1	1	0	0
Write VHDL and program FPGAs write assembly and C code for microcontroller and build embedded systems in a laboratory environment.	3	0	0	0	0	0	0	0	3	3	0	0	0
Make short presentations in class about contemporary topics	1	0	0	0	2	3	0	0	3	1	0	0	2

concerning embedded systems such as security energy novel circuit structures graphic interfaces ubiquitous computing and ethics.													

Catalog Description:
Introduction to hardware and software design of digital computing systems embedded in electronic devices (such as digital cameras or portable video games). Topics include custom and programmable processor design, standard peripherals, memories, interfacing, and hardware/software tradeoffs. Laboratory involves use of synthesis tools, programmable logic, and microcontrollers and development of working embedded systems. Cross-listed with EE 120B.

Requirement Status: Required

EE 128: DATA ACQUISITION, INSTRUMENTATION, AND PROCESS CONTROL

Credits and Contact Hours
4.0 Units
Lecture: MWF 12.10 pm – 1pm; MSE 113
Lab: W 8.10 am – 11.00 am; EBU-II 128
Lab: F 8.10 am – 11.00 am; EBU-II 128

Instructor and TA
Matthew Barth, Professor, Dept. of Electrical Engineering;
WCH 342
TA: Hongliang Pan, WCH 371

Textbooks and Related Materials
1. (Reference) Han-Way Huang, "The HCS12/9S12: An Introduction to Software and Hardware Interfacing", Publisher: Thomson Delmar Learning (www.delmarlearning.com), ISBN: 1-4018-9812-2, First Printing, 2006.
2. (Reference) R. Haskell, and D. Hanna, "Learning by Example Using C: Programming the miniDRAGON-Plus2 Using CodeWarrior", Publisher: LBE Books, LLC (www.lbebooks.com), ISBN: 978-0-9801337-2-1, First Printing, 2008.

Course Description (Catalog Description)
Analog signal transducers, conditioning and processing; step motors, DC servo motors, and other actuation devices; analog to digital and digital to analog converters; data acquisition systems; microcomputer interfaces to commonly used sensors and actuators; design principles for electronic instruments, real time process control and instrumentation.

Prerequisite(s)
EE100B, EE/CS-120A, or consent of instructor. You must be able to program in C (or C++).

Course Type
Electrical Engineering, technical elective.

Course Objectives
1. Ability to implement Boolean logic in software; includes techniques on how to read and write bit-level memory;
2. Ability to understand and design general architectures of a microcontroller-based digital system and their application to real-time process control;
3. Form fundamental understanding of a bus-architecture system and be able to interface memory and peripheral hardware within;
4. Ability to understand how interrupts work within microprocessor/microcontroller systems; design a process control system using interrupts;
5. Understand fundamentals of sequence- and state-machines and learn how to

implement a process as a sequence- or state-machine;
6. Learn principles of digital-to-analog and analog-to-digital conversion and techniques of implementation;
7. Learn principles of serial & parallel communications, timers & counters (e.g., output compares, input captures, pulse accumulation) and techniques of implementation;
8. Ability to understand how a variety of sensors and actuators can be interfaced to a microcontroller system; key emphasis is on the design of interface circuitry.

<u>Student Outcomes Addressed</u>

Item	COURSE OBJECTIVES	OUTCOMES										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Ability to implement Boolean logic in software			1								
2	Ability to understand and design general architectures of a microcontroller-based digital system			1								
3	Fundamental understanding of a bus-architecture system			1								
4	Ability to understand how interrupts work within microprocessor / microcontroller systems; design a process control system using interrupts		1	1								
5	Understand fundamentals of sequence- and state-machines and learn how to implement a process as a sequence- or state-machine		1	1								
6	Learn principles of digital-to-analog and analog-to-digital conversion and techniques of implementation		1	1								
7	Learn principles of serial & parallel communications, timers & counters (e.g., output compares, input captures, pulse accumulation) and techniques of implementation		1	1								
8	Ability to understand how a variety of sensors and actuators can be interfaced to a microcontroller system; key emphasis is on the design of interface circuitry		1	1								

EE132: AUTOMATIC CONTROL SYSTEMS

Credits and Contact Hours
4.0 Units
Lecture: TR 9:40am – 11:00am, MSE 103
Lab: MW Check classes.ucr.edu for times, CHUNG 125
Office Hours:
Instructor: R 11:00am – 12:00pm

Instructor and TA
Feras Abou-Galala, Lecturer, Dept. of Electrical Engineering, feras@ieee.org, WCH411
TA: Rathavut Vanitsthian rvanitsthian@ee.ucr.edu, WCH 109

Textbooks and Related Materials
1. (**Text**) Control Systems Engineering, N. S. Wise, 6th Ed., John Wiley and Sons.

Course Description (Catalog Description)
This is a one quarter course for four credits. The subject matter includes the design and analysis of control systems. It is assumed that the student is familiar with ODE's, Laplace transforms, complex variables, transfer functions, and modeling. Specific topics to be covered include:
Time domain performance, Laplace domain analysis, Control system design, Performance Metrics
Stability analysis by Routh's Criterion, Root locus, and Nyquist Criterion

Prerequisite(s)
EE105, EE110A or consent of instructor

Course Type
Electrical Engineering, required.

Course Objectives
1. Basic skills of analyzing time-domain performance
2. Perform the Laplace transform to obtain the transfer function of the system
3. Understand the basic components and requirements of Control System Design
4. Analyze and design control systems based on give performance metrices
5. Analyze and design systems for given stability requirements based on Routh's Criterion
6. Use the Root Locus and the Nyquist Criterion to analyze systems transient response
7. Design and analyze PI, PD, and PID controllers
8. Calculate Transfer Functions and perform computation using MATLAB

Student Outcomes Addressed

Item	COURSE OBJECTIVES	OUTCOMES										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Basic skills of analyzing time-domain performance	1										
2	Perform the Laplace transform to obtain the transfer function of the system	1										
3	Understand the basic components and requirements of Control System Design	1										
4	Analyze and design control systems based on give performance metrices	1										
5	Analyze and design systems for given stability requirements based on Routh's Criterion	1		1								
6	Use the Root Locus and the Nyquist Criterion to analyze systems transient response	1		1								
7	Design and analyze PI, PD, and PID controllers	1		1								
8	Calculate Transfer Functions and perform computation using MATLAB	1				1						

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE 133: SOLID-STATE ELECTRONICS

Credits and Contact Hours
4.0 Units
Lecture: TR, 5:10 pm – 6:30 pm , MSE 113
Discussion: W, 2:10 pm – 3 pm, WAT 2240

Instructor and TA
Alexander Korotkov, Professor, Dept. of Electrical Engineering; WCH 434
TA: Zonglin Li, zli006@ucr.edu

Textbooks and Related Materials
1. (Text) "Solid State Electronic Devices," (6th ed.) by Ben G. Streetman and Sanjay K. Banerjee, Pearson Prentice Hall, 2006, ISBN: 0-13-149726-X.

Course Description (Catalog Description)
Presents the fundamentals of solid-state electronics. Topics include electronic band structure, Fermi and quasi-Fermi levels; doping; contacts; junctions; field-effect, bipolar, and metal-oxide-semiconductor (MOS) transistors; and charge-coupled devices. Also reviews device fabrication concepts.

Prerequisite(s)
EE100A

Course Type
Electrical Engineering, elective.

Course Objectives
1. Ability to determine crystallographic directions, planes, equivalent directions, and equivalent planes.
2. Understand an energy band diagram including Ec, Ev, Ei, Ef, Fn, and Fp.
3. Understand the relationship between the applied voltage and the movement of the quasi-Fermi levels.
4. Ability to determine the depletion width of a pn junction diode.
5. Ability to determine the depletion capacitance of a pn junction diode.
6. Ability to determine the current of a pn junction diode.
7. Ability to draw and recognize the band diagram of a pn junction diode in forward and reverse bias.
8. Understand fundamentals of BJTs.
9. Ability to determine the flat-band voltage and the threshold voltage of a MOS capacitor.
10. Ability to determine the threshold voltage from a MOS C-V curve.

B. <u>Student Outcomes Addressed</u>

Item	COURSE OBJECTIVES	OUTCOMES										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Ability to determine crystallographic directions, planes, equivalent directions, and equivalent planes.	1										
2	Understand an energy band diagram including Ec, Ev, Ei, Ef, Fn, and Fp.					1						
3	Understand the relationship between the applied voltage and the movement of the quasi-Fermi levels.					1						
4	Ability to determine the depletion width of a pn junction diode.	1										
5	Ability to determine the depletion capacitance of a pn junction diode.	1										
6	Ability to determine the current of a pn junction diode.	1										
7	Ability to draw and recognize the band diagram of a pn junction diode in forward and reverse bias.					1						
8	Understand fundamentals of BJTs.	1										
9	Ability to determine the flat-band voltage and the threshold voltage of a MOS capacitor.	1										
10	Ability to determine the threshold voltage from a MOS C-V curve.	1										

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE 134: DIGITAL INTEGRATED CIRCUIT LAYOUT AND DESIGN

Credits and Contact Hours
4.0 Units
Lecture: TR 8:10 am – 9:30 am Olmsted Hall 1136
Lab: M 8:10 am – 11:00 am WCH 125

Office Hours:
Instructor: T 2:00 pm – 3:00 pm, WCH 322

Instructor and TA
Instructor: Qi Zhu, Assistant Professor, Dept. of Electrical Engineering, WCH 322
TA: Yuan Tian, WCH 461

Textbooks and Related Materials
1. (Text) Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic, "Digital Integrated Circuits", 2nd Edition, Prentice Hall.

Course Description (Catalog Description)
The objective of this course is to introduce the student to CMOS (complementary metal-oxide-semiconductor) digital integrated circuit layout and design. The course covers CMOS integrated circuit design, layout and verification using CAD (computer-aided design) tools. Topics include digital models, inverters, static logic gates, transmission gates, flip-flops, and dynamic logic gates.

Prerequisite(s)
CS 120A / EE 120A, EE 001A, EE 001B, EE 100A, EE 100B, EE 133

Course Type
Electrical Engineering

Specific Course Information

A. Course Objectives

1. Basic knowledge of the integrated circuit manufacturing process.
2. Understanding of the device model for modern CMOS transistors.
3. Understanding of the operation modes of CMOS inverters.
4. Ability to calculate delays of inverters and logic gates.
5. Ability to size a chain of inverters to drive a large capacitive load.
6. Understanding of static CMOS logic gates.
7. Understanding of latches and registers.
8. Ability to layout, DRC and LVS CMOS digital integrated circuits.

B. Student Outcomes Addressed

Item	COURSE OBJECTIVES	OUTCOMES										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Basic knowledge of the integrated circuit manufacturing process	1									1	
2	Understanding of the device model for modern CMOS transistors	1										
3	Understanding of the operation modes of CMOS inverters	1										
4	Ability to calculate delays of inverters and logic gates	1				1						
5	Ability to size a chain of inverters to drive a large capacitive load	1		1		1						
6	Understanding of static CMOS logic gates	1										
7	Understanding of latches and registers	1										
8	Ability to layout, DRC and LVS CMOS digital integrated circuits		1	1	1	1		1				

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.

Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE 135: ANALOG INTEGRATED CIRCUIT LAYOUT AND DESIGN

Credits and Contact Hours
4.0 Units
Lecture: W 3.10 pm – 6pm; WCH 128
Laboratory: T 5.10 pm – 8.00 pm; WCH 128

Instructor and TA
Albert Wang, Associate Professor, Dept. of Electrical Engineering;
WCH 417
TA: None

Textbooks and Related Materials

1. (Text) *Analysis and Design of Analog Integrated Circuits*, Gray, Hurst, Lewis & Meyer

Specific Course Information

A. Course Description (Catalog description)
Covers analog circuit design, layout, and verification of CMOS with use of computer-aided design tools. Topics covered are analog MOSFET models, current sources, references, amplified design, etc.

B. Prerequisite(s)
EE 001A/B & EE 100A/B & EE 133 & EE 134; or consent of instructor

C. Course Type
Electrical Engineering, technical elective.

Specific Course Information

A. Course Objectives
1. Introduction to integrated circuits.
2. Bipolar and MOS IC technologies.
3. IC device modeling.
4. Single-transistor and multi-transistor amplifiers.
5. Biasing and loading circuits.
6. Output stage circuits.
7. Operational Amplifiers.

B. Student Outcomes Addressed

Item	COURSE OBJECTIVES	OUTCOMES										
		A	B	C	D	E	F	G	H	I	J	K
1	Introduction to integrated circuits	1										1
2	Bipolar and MOS IC technologies	1										1
3	IC device modeling	1										1
4	Single-transistor and multi-transistor amplifiers.	1	1			1						1
5	Biasing and loading circuits	1	1			1						1
6	Output stage circuits	1	1			1						1
7	Operational Amplifiers	1	1			1						1

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice

EE 136: SEMICONDUCTOR DEVICE PROCESSING

Credits and Contact Hours
4.0 Units
Lecture: TR 12:40 pm – 2pm; HMNSS1404
Lab: F 5:10pm-8:00pm; Pierce Hall 1441

Office Hours:
Instructor: R 3:10 pm – 4:00 pm; WCH 439

Instructor and TA
Jianlin Liu, Professor, Dept. of Electrical Engineering; WCH 439
TA: Jian Huang, WCH 228

Textbooks and Related Materials

1. (Text) Richard C. Jaeger, Introduction to Microelectronic Fabrication, Modular Series on Solid State Devices, second edition, ISBN: 0-201-44494-1; Coverage to include chapters 1-9, etc.
5. (Reference) a) Lecture handouts at ilearn ; b) Lab lecture handouts at ilearn; c) Peter Van Zant, Microchip Fabrication, fifth edition, ISBN: 0-07-143241-8; d) S. Wolf and R. N. Tauber, Silicon Processing for the VLSI Era, Volume 1 Process Technology, Second Edition, ISBN: 0-9616721-6-1; e) Online reading: nanohub.org

Course Description (Catalog Description)
This EE undergraduate course presents device/process simulations and hands-on experience in Integrated Circuit (IC) fabrication and characterization techniques. Students will work in the Microelectronics Laboratory (teaching clean room) to learn fabrication processes of NMOSFET transistors. Electrical evaluation of these devices and simulations of these devices will be performed.

Prerequisite(s)
EE133 or consent of instructor

Course Type
Electrical Engineering, technical elective course for undergraduate students and graduate students in the Nano-materials and Devices area

A. Course Objectives

1. Learn basic theories/skills required for semiconductor device fabrication, characterization and simulation.
2. Learn processes and process modules such as lithography, oxidation, film deposition, etching and metallization.
3. Learn process integration of metal-oxide-semiconductor-field-effect transistors.
4. Learn device characterization techniques.
5. Learn device simulation and process simulation.

6. Learn how to write technical reports and technical papers (IEEE-type).
7. Learn the importance of teaming in a project.
8. Learn how a graduate student normally does research.

B. Student Outcomes Addressed

Item	COURSE OBJECTIVES	OUTCOMES										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	In one or two sentences explain what are: semiconductors, Si, doping, metal oxide semiconductor field effect transistor					3		3	1	1		
2	Understand the current density equations and continuity equations to simulate output and trasfer characteristics of a MOSFET	3										
3	Understand the technology node and scaling limits	3		1								
4	Define photolithography process steps to fabricate a NMOSFET	2										
5	Understand Si oxidation		3					3				
6	Understand film deposition methods	3		1								
7	Understand ion implantation process					1		2				
8	Understand theory and process of metal contact to MOSFET	3										
9	Photolithography and metalization process and fabrication/characterization		3									

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE137- INTRODUCTION TO SEMICONDUCTOR OPTOELECTRONIC DEVICES

Credits and Contact Hours
4.0 Units
Lecture: Tu-Th 11:10am-12:30 pm; SURGE 172
Discussion: M 3.10 pm – 4.00 pm; PRCE 3374

Office Hours:
Instructor: W 1-2pm
Reader: TR 1-3pm

Instructor and Reader
Mihri Ozkan, Professor, Dept. of Electrical Engineering;
MSE 319
Reader: Isaac Ruiz, WCH 207

Textbooks and Related Materials
1. (Text book) Optoelectronics an Introduction, 3rd edition by John Wilson and John Hawkes
2. Coldren, and Corzine. Diode Lasers and Photonic Integrated Circuits. 1st ed. New York, NY: Wiley-Interscience, October 16, 1995. ISBN: 0471118753.
3. Chuang, S. L. Physics of Optoelectronic Devices. New York, NY: Wiley-Interscience, September 8, 1995. ISBN: 0471109398.
4. Pallab Bhattacharya, Semiconductor optoelectronic devices, 1994
5. S.C. Gupta, Optoelectronic devices and systems, 2005
6. Wallace B. Leigh, Devices for optoelectronics, 1996

Course Description (Catalog Description)
An introduction to semiconductor optoelectronic devices for optoelectronic communications and signal processing. Topics include basic optical processes in semiconductors, semiconductor light-emitting diode, semiconductor heterojunction lasers, photodetectors, solar cells, optoelectronic modulation, and switching devices.

Prerequisite(s)
EE 133

Course Type
Electrical Engineering, technical elective.

Course Objectives
1. Introduction to basic concepts of semiconductors
2. Introduction to basic concepts of light and semiconductor interaction
3. Understanding the role of types of semiconductors on optoelectronic device fabrication

4. Introduction to p-n junctions
5. Introduction to forward biased p-n junction devices
6. Introduction to reverse biased p-n junction devices
7. Learning of real-life applications of semiconductor optoelectronic devices
8. Design of new semiconductor optoelectronic devices for better performance

<u>Student Outcomes Addressed</u>

		OUTCOMES										
Item	**COURSE OBJECTIVES**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Introduction to basic concepts of semiconductors	1										
2	Introduction to basic concepts of light and semiconductor interaction	1										
3	Understanding the role of types of semiconductors on optoelectronic device fabrication											
4	Introduction to p-n junctions											
5	Introduction to forward biased p-n junction devices	1		1								
6	Introduction to reverse biased p-n junction devices	1										
7	Learning of real-life applications of semiconductor optoelectronic devices	1				1						
8	Design of new semiconductor optoelectronic devices for better performance					1		1				
Subtotals		5		1		3		1				

A. Ability to apply knowledge of mathematics, science, and engineering.
B. Ability to design and conduct experiments, as well as analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate, and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

EE 138: ELECTRICAL PROPERTIES OF MATERIALS

Credits and Contact Hours
4.0 Units
Lecture: MWF 3:10 pm – 4:00 pm ENGR2 139
Discussion: W 5:10 pm – 6:00 pm OLMH 1127

Office Hours:
Instructor: T 3:00 – 4:00 pm
TA: R 2:00 – 3:00 pm

Instructor and TA
Elaine D. Haberer, Assistant Professor, Dept. of Electrical Engineering;
WCH 418
TA: Zhonglin Li, WCH 109
Textbooks and Related Materials
(Text) Electronic Properties of Engineering Materials
James D. Livingston, John Wiley & Sons, Inc. New York, NY 1999
(1 copy on RESERVE in the Science Library)

Course Description (Catalog Description)
Introduces the electrical properties of materials. Includes the electron as a particle and a wave; hydrogen atom and the periodic table; chemical bonds; free-electron theory of metals; band theory of solids; semiconductors and dielectrics; measurements of material properties; and growth and preparation of semiconductors.

Prerequisite(s)
Upper division standing; PHYS 040C or equivalent

Course Type
Electrical Engineering, technical elective; Materials Science and Engineering, required.

Course Objectives
1. Understand conduction mechanisms (free and bound electrons) in metals and dielectrics.
2. Understand electromagnetic wave (light) interactions with metals and dielectrics.
3. Understand the difference in treating electrons as particles or waves.
4. Understand and analyze 1D quantum mechanical problems such as potential walls and wells.
5. Understand the origin of the periodic table of elements based on the model of the hydrogen atom.
6. Learn principles of the band theory of solids and differentiate between metals, semiconductors, and insulators
7. Understand intrinsic and extrinsic semiconductors and the physical principles of conduction for each (majority and minority carriers)
8. Understand the basic principles of semiconductor devices

9. Understand basic principles of magnetic materials and differentiate between soft and hard magnets

<u>Student Outcomes Addressed</u>

Item	COURSE OBJECTIVES	**OUTCOMES**										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Understand conduction mechanisms in metals and dielectrics	1										
2	Understand electromagnetic wave (light) interactions with metals and dielectrics	1										
3	Understand the difference in treating electrons as particles or waves	1										
4	Understand and analyze 1D quantum mechanical problems	1										
5	Understand the origin of the periodic table of elements	1										
6	Learn principles of the band theory of solids					1						
7	Understand intrinsic and extrinsic semiconductors and the physical principles of conduction for each	1										
8	Understand basic principles of semiconductor devices					1						
9	Understand basic principles of magnetic materials and differentiate between soft and hard magnets					1						

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE 139: MAGNETIC MATERIALS

Credits and Contact Hours

4.0 Units
Lecture: TR 5.10 pm – 6.30pm; MSE 113
Discussion: M 4.10 pm – 5.00 pm; MSE 003

Instructor and TA

Roman Chomko, Lecturer, Dept. of Electrical Engineering;
WCH 411
TA: Zhong Yan, WCH 109

Textbooks and Related Materials

1. (Text) B. D. Cullity and C. D. Graham, "Introduction to Magnetic Materials", 2^{nd} edition, Wiley-IEEE, 2009
2. (Reference) Sóshin Chikazumi, "Physics of Ferromagnetism", 2^{nd} edition, Oxford University Press, 2009

Specific Course Information

A. Course Description (Catalog description)

Introduces fundamentals of magnetic materials for the next-generation magnetic, nanomagnetic, and spintronics-related technologies. Includes basics of magnetism, models of the equivalent magnetic charge and current, paramagnetic and diamagnetic materials, soft and hard magnetic materials, equivalent magnetic circuits, and magnetic system design foundations.

B. Prerequisite(s)

Upper-division standing; **PHYS 040C** or equivalent

C. Course Type

Electrical Engineering, elective.

Specific Goals

A. Course Objectives

1. Electromagnetics with Magnetic Materials (Inductors, Magnetic Circuits).
2. Types of Magnetism.
3. Magnetic Phenomena.
4. Magnetic Measurements.
5. Magnetic Materials and Metallurgy.
6. Introduction to random processes and their applications.
7. Application of Magnetic Materials.

B. Student Outcomes Addressed

Item	COURSE OBJECTIVES	OUTCOMES A	B	C	D	E	F	G	H	I	J	K
1	Generation of Magnetic Fields: coils, electromagnets, magnetic circuits	1										
2	Origin of magnetization, magnetic moment of atoms											
3	Susceptibility and Permeability, Demagnetizing fields, and shape anisotropy	1										
4	Understanding of the origin of diamagnetism, Larmor's precession of atomic magnetic moments											
5	Understanding that paramagnetism is due to thermal interactions, Curie Law	1										
6	Understanding of origin of ferromagnetism according to the Weiss molecular fields, exchange interactions											
7	Understanding of the Weiss molecular fields approach to explain antiferromagnetism and ferrimagnetism, composition of ferrites and their properties	1										
8	Understanding of crystalline anisotropy, hard and easy axes of magnetization	1	1	1								
9	Understanding the origin of magnetic domains, hysteresis. Soft and hard magnetic materials	1	1	1								

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE 141 DIGITAL SIGNAL PROCESSING

Credits and Contact Hours
4.0 Units
Lecture: TR 02:10 p.m. - 03:30 p.m. BOYHL 1471
Laboratory: Section 021 M 08:10 a.m. - 11:00 a.m. ENGR2 125
Section 022 T 08:10 a.m. - 11:00 a.m. ENGR2 125

Instructor and TA
Ping Liang, Associate Professor, Dept. of Electrical Engineering; WCH 323
Office Hours: TR: 3:30-5:00pm

TA: Yingying Zhu, WCH 109
Office Hours: MW 1:00-2:00pm

Grading: Lab 20%, Homework 5%, Mid-Terms 35%, and Final Exam 40%

Textbook and Related Materials
(Text) A. V. Oppenheim, R. W. Schafer, and J. R. Buck, Discrete-Time Signal Processing, 3rd edition, Prentice Hall.

Course Description (Catalog Description)
Transform analysis of Linear Time-Invariant (LTI) systems, discrete Fourier Transform (DFT) and its computation, Fourier analysis of signals using the DFT, filter design techniques, structures for discrete-time systems. Laboratory experiments on DFT, fast Fourier transforms (FFT), infinite impulse response (IIR), and finite impulse response (FIR) filter design, and quantization effects.

Prerequisite(s)
EE110B

Course Type
Electrical Engineering, required.

Course Objectives
9. Students know the differences between continuous-time Fourier transform (CTFT) and discrete-time Fourier transform (DTFT).
10. Students know the difference between discrete-time Fourier transform (DTFT) and discrete Fourier transform (DFT).
11. Students know fast Fourier transform (FFT) and how to implement.
12. Students know how to design FIR and IIR filters (low pass, high pass, band pass).
13. Students know how to design FIR filters (low pass, high pass, band pass, generalized linear phase, Kaiser window, multiband filter).
14. Students know sampling, up and down sampling, A/D conversion, oversampling, noise-shaping in sigma-delta modulation A/D

15. Students know how to use FFT/IFFT and circular convolution to implement fast linear filtering of practical digital signals
16. Students understand the importance of DSP in electrical engineering systems and applications and know examples of DSP applications

Student Outcomes Addressed

		OUTCOMES										
Item	**COURSE OBJECTIVES**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Students know the difference between continuous time Fourier transform (CTFT) and discrete-time Fourier transform (DTFT)	1										
2	Students know the difference between DTFT and discrete Fourier transform (DFT)	1										
3	Students know fast Fourier transform (FFT) and how to implement	1										
4	Students know how to design FIR and IIR filters (low pass, high pass, band pass)					1						
5	Students know how to design FIT filters (low pass, high pass, band pass, generalized linear phase, Kaiser window, multiband filter)					1						
6	Students know sampling, up and down sampling, A/D conversion, and oversampling	1				1						
7	Students know how to use FFT/IFFT and circular convolution to implement fast linear filtering of practical digital signals	1				1						
8	Students understand the importance of DSP in electrical engineering systems and applications and know examples of DSP applications					1						

EE 144: INTRODUCTION TO ROBOTICS

Credits and Contact Hours
4.0 Units
Lecture: TR 9.40 am – 11am; HMNSS 1404
Labs W 11:10-2am WCH 128

Instructor and TA
A. Mourikis, Assistant Professor, Dept. of Electrical Engineering; WCH 306
TA: M. Li WCH 109

Textbooks and Related Materials
1. (Text) J.J Craig, "Introduction to Robotics: Mechanics and Control," 3rd Ed, Pearson Prentice Hall, 2005.

Course Description (Catalog Description)
Basic robot components from encoders to microprocessors. Kinematic and dynamic analysis of manipulators. Open-and closed-loop control strategies, task planning, contact and noncontact sensors, robotic image understanding, and robotic programming languages. Experiments and projects include robot arm programming, robot vision, and mobile robots.

Prerequisite(s)
EE132

Course Type
Electrical Engineering, technical elective

Course Objectives
1. Understand and describe the structure of a robot manipulator.
2. Describe and analyze the position and orientation of frames in 3D.
3. Derive models for the forward and inverse kinematics of a manipulator
4. Utilize robot sensor data, such as images from a camera, to perceive objects in a robot's surroundings.
5. Program a mobile robot for performing simple tasks.

B. Student Outcomes Addressed

Item	COURSE OBJECTIVES	OUTCOMES A	B	C	D	E	F	G	H	I	J	K
1	Understand and describe the structure of a robot manipulator.	1										
2	Describe and analyze the position and orientation of frames in 3D	1										
3	Derive models for the forward and inverse kinematics of a manipulator	1										
4	Utilize robot sensor data, such as images from a camera, to perceive objects in a robot's surroundings.	1		1								
5	Program a mobile robot for performing simple tasks.	1		1								

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE 146: COMPUTER VISION

Credits and Contact Hours
4.0 Units
Lecture: TR 12.40 pm – 2pm; WCH 141
Labs W 8:10-11am WCH 125

Instructor and TA
A. Mourikis, Assistant Professor, Dept. of Electrical Engineering; WCH 306
TA: Ramya Malur Srinivasan WCH 371

Textbooks and Related Materials
1. (Text) L. Shapiro and G. Stockman "Computer Vision," Prentice Hall, 2001.

Course Description (Catalog Description)
Imaging formation, early vision processing, boundary detection, region growing, two-dimensional and three-dimensional object representation and recognition techniques. Experiments for each topic are carried out.

Prerequisite(s)
Senior standing in Computer Science or Electrical Engineering, or consent of instructor.

Course Type
Electrical Engineering, technical elective

Course Objectives
1. Understand the fundamentals of digital image capturing and manipulation on a computer
2. Apply basic image processing algorithms.
3. Understand the basics of image-based object recognition.
4. Understand key types of features that can be extracted in images to aid in high-level image understanding tasks.
5. Understand the geometric model of a camera

Student Outcomes Addressed

Item	COURSE OBJECTIVES	OUTCOMES										
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Fundamentals of digital image capturing and manipulation on a computer	1										
2	Basic image processing algorithms.	1										
3	Basics of image-based object recognition.	1	1									
4	Features that can be extracted in images to aid in high-level image understanding tasks.	1	1									
5	Understand the geometric model of a camera	1										

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE 150 DIGITAL COMMUNICATION

Credits and Contact Hours
4.0 Units
Lecture: TR 2:10pm - 3:30 pm; WCH 142
Discussion: W 1:10 pm - 2:00 pm; ***PRCE 3374***

Office Hours:
Instructor: W 4:00 – 5:00pm
TA: W 3:00 – 4:00pm

Instructor and TA
Ilya Dumer, Professor, Dept. of Electrical Engineering;
WCH 427
TA: Olga Kapralova, WCH 461

Textbooks and Related Materials
Textbooks:

1. B.P. Lathi, Modern Digital and Analog Comm. Systems, 3rd Ed.; Oxford, 1998 (ISBN 019511009-9) or :
2. B.P. Lathi and Zhi Ding. Modern Digital and Analog Comm. Systems, 4^{th} ed. Oxford, 2009 (ISBN 0195331451)

References:
1. Simon Haykin, Communication Systems, Wiley, 4^{th} Edition, 2001 (ISBN 0-471-17869-1).
2. Leon W. Couch, Digital and Analog Communication Systems, 4^{th} ed. Macmillan Publ. Co., 1993

Course Description (Catalog Description)
Topics include modulation, probability and random variables, correlation and power spectra, information theory, errors of transmission, equalization and coding methods, shift and phase keying, and a comparison of digital communication systems.

Prerequisite(s)
EE114 and EE115

Course Type
Electrical Engineering, elective.

Course Objective

1. Analysis of the frequency response and power spectral density of low-pass and band-pass signals.
2. Analysis of frequency response of random signals (polar, Manchester, bipolar, duobinary signaling).
3. Analysis and design of pulse code modulation. Analysis of ISI and Nyquist criteria
4. Analysis of random variables, their sums and distributions in communication design

5. Analysis and design of PCM systems corrupted by both quantization and channel noise

<u>Student Outcomes Addressed</u>

		OUTCOMES										
Item	**COURSE OBJECTIVES**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1	Analysis of the frequency response and power spectral density of low-pass and band-pass signals	3				1						
2	Analysis of frequency response of random signals (polar, Manchester, bipolar, duobinary signaling)	3				1						
3	Analysis and design of pulse code modulation. Analysis of ISI and Nyquist criteria	2				3						
4	Analysis of random variables, their sums and distributions in communication design	2				3						
5	Analysis and design of PCM systems corrupted by both quantization and channel noise	3				2						

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE 151: INTODUCTION TO DIGITAL CONTROL (Spring 2011)

Credits and Contact Hours
4.0 Units
Lecture: TR 6.40 pm – 8pm; SPTH 1222
laboratory: F 11:10 am – 2 pm; ENGR2 128

Office Hours:
Instructor: R 5:20 pm-6:30 pm ENGR2 411
TA: TR 4pm – 4:50 pm

Instructor and TA
Hossny El-Sherief, Adjunct Professor, Dept. of Electrical Engineering; ENGR2 411
TA: Stefan Pitzek, ENGR2 TA office

Textbooks and Related Materials
1. (Text) K Ogata, "Discrete Time Control Systems", 2nd Edition, Prentice Hall.

Course Description (Catalog Description)
Review of continuous-time control systems; review of Z-transform and properties; sampled-data systems; stability analysis and criteria; frequency domain analysis and design; transient and steady-state response; state-space techniques; controllability and observability; pole placement; observer design; Lyapunov stability analysis. Laboratory experiments complementary to these topics include simulations and design.

Prerequisite(s)
EE132 and EE141 or consent of instructor

Course Type
Electrical Engineering, elective.

Course Objectives
1. Understand and be able to explain the advantage of digital control systems.
2. Be able to perform Z-transform of control system transfer function.
3. Understand the different classical methods for designing digital control systems.
4. Understand the state space method for designing digital control systems.
5. Perform laboratory experiments to design and evaluate digital control systems.
6. Design a digital control system to meet desired gain and phase margin requirements.
7. Learn how to calculate the controllability and observability of digital control systems in the state space representation.

Student Outcomes Addressed

Item	COURSE OBJECTIVES	OUTCOMES										
		A	B	C	D	E	F	G	H	I	J	K
1	Understand and be able to explain the advantage of digital control systems											
2	Be able to perform Z-transform of control system transfer function	1										
3	Understand the different classical methods for designing digital control systems	1										
4	Understand the state space method for designing digital control systems	1				1						
5	Perform laboratory experiments to design and evaluate digital control systems		1		1							
6	Design a digital control system to meet desired gain and phase margin requirements	1										
7	Learn how to calculate the controllability and observability of digital control systems in the state space representation	1		1		1						

A. Ability to apply knowledge of mathematics, science and engineering
B. Ability to design and conduct experiments, as well as, analyze and interpret data.
C. Ability to design a system, component, or process to meet desired needs.
D. Ability to function on multidisciplinary teams.
E. Ability to identify, formulate and solve engineering problems.
F. Understanding of professional and ethical responsibility.
G. Ability to communicate effectively.
H. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. Recognition of the need for and an ability to engage in lifelong learning.
J. Knowledge of contemporary issues.
K. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

EE 175A: SENIOR DESIGN PROJECT
Winter 2012

Credits and Contact Hours
4.0 Units
Lecture: F 03:10 p.m. - 04:00 p.m. ENGR2 143
Laboratory: Section 021 F 08:10am-11a.m. ENGR2 121
Section 022 W 04:10pm-7pm ENGR2 128

Instructors
Ping Liang, Assoc Prof, Electrical Engineering; ENGR2 323, 827-2261 liang@ee.ucr.edu
Roman Chomko, Lecturer, Electrical Engineering; ENGR2 411 827-7109 chomko@ee.ucr.edu
Elmar Palma, Assoc Development Engineer, EE Labs Manager, ENGR2 137 epalma@ee.ucr.edu

Textbook and Related Materials
No textbook required. All course materials are posted on iLearn.

Specific Course Information
A. Course Description (Catalog description)
The proposal and design of electrical engineering devices or systems under the direction of a faculty member. Emphasizes professional and ethical responsibilities, as well as the need to stay current on technology and its global impact on economics, society, and the environment.

B. Prerequisite(s)
ENGR 180W, senior standing in Electrical Engineering.

C. Course Type
Electrical Engineering, required.

Specific Objectives
A. Course Objectives
1. Ability to understand the engineering design process, working in teams.
2. Ability to formulate design specifications and evaluation criteria; determining methodologies and performing solution analyses
3. Develop skills in project management including organization, teamwork, planning, scheduling, and budgeting
4. Develop skills in library techniques such as literature and information searching
5. Develop technical writing and oral communication skills through proposal and report writing, as well as mid-course and final presentations
6. Ability to design and conduct experiments and analyze data
7. Understanding of professional and ethical responsibility
8. Obtain a general understanding of engineering economics, marketing, career strategies, and resume preparation.
9. Understand the impact of engineering solutions in a global and societal context

10. Knowledge of contemporary engineering issues

B. Student Outcomes Addressed

Item	OUTCOME-RELATED LEARNING OBJECTIVES	A	B	C	D	E	F	G	H	I	J	K
1	Ability to understand the engineering design process, working in teams.			1	1	1					1	1
2	Ability to formulate design specifications and evaluation criteria; determining methodologies and performing solution analyses	1	1	1		1						1
3	Develop skills in project management including organization, teamwork, planning, scheduling, and budgeting			1	1	1					1	1
4	Develop skills in library techniques such as literature and information searching							1		1	1	1
5	Develop technical writing and oral communication skills through proposal and report writing, as well as mid-course and final presentations					1		1				1
6	Ability to design and conduct experiments and analyze data	1	1	1								1
7	Understanding of professional and ethical responsibility						1					1
8	Obtain a general understanding of engineering economics, marketing, career strategies, and resume preparation.						1		1	1		1
9	Understand the impact of engineering solutions in a global and societal context								1			1
10	Knowledge of contemporary engineering issues									1	1	1

List of Topics

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

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

1. A Clear Technical Design Objective and the Project Contract
2. Experiment Design and Feasibility Study
3. A Detailed Design Specification
4. Global, Economic, Environmental and Societal Impact
5. Contemporary Engineering Issues
6. Test Plan
7. Understanding of Professional and Ethical Responsibility
8. Recognition of the need for and an ability to engage in lifelong learning
9. Design Review Presentation
10. Detailed Quantitative Design and Prototype
11. Test Report
12. Final Presentation
13. Working Demo and Final Report

EE 175B: SENIOR DESIGN PROJECT
Spring 2012

Credits and Contact Hours
4.0 Units
Lecture: M 10:10 a.m. - 11:00 a.m. SPTH 1307
Laboratory: Section 021 W 03:10 p.m. - 06:00 p.m. CHUNG 128
Section 022 W 03:10 p.m. - 06:00 p.m. CHUNG 125

Instructors
Ping Liang, Assoc Prof, Electrical Engineering; ENGR2 323, 827-2261 liang@ee.ucr.edu
Roman Chomko, Lecturer, Electrical Engineering; ENGR2 411 827-7109 chomko@ee.ucr.edu
Elmar Palma, Assoc Development Engineer, EE Labs Manager, ENGR2 137 epalma@ee.ucr.edu

Textbook and Related Materials
No textbook required. All course materials are posted on iLearn.

Specific Course Information
C. Course Description (Catalog description)
The proposal and design of electrical engineering devices or systems under the direction of a faculty member. Emphasizes professional and ethical responsibilities, as well as the need to stay current on technology and its global impact on economics, society, and the environment.

B. Prerequisite(s)
ENGR 180W, senior standing in Electrical Engineering.

C. Course Type
Electrical Engineering, required.

Specific Objectives
A. Course Objectives
1. Ability to understand the engineering design process, working in teams.
2. Ability to formulate design specifications and evaluation criteria; determining methodologies and performing solution analyses
3. Develop skills in project management including organization, teamwork, planning, scheduling, and budgeting
4. Develop skills in library techniques such as literature and information searching
5. Develop technical writing and oral communication skills through proposal and report writing, as well as mid-course and final presentations
6. Ability to design and conduct experiments and analyze data
7. Understanding of professional and ethical responsibility
8. Obtain a general understanding of engineering economics, marketing, career strategies, and resume preparation.
9. Understand the impact of engineering solutions in a global and societal context

Knowledge of contemporary engineering issues

D. Student Outcomes Addressed

Item	OUTCOME-RELATED LEARNING OBJECTIVES	OUTCOMES A	B	C	D	E	F	G	H	I	J	K
1	Ability to understand the engineering design process, working in teams.			1	1	1					1	1
2	Ability to formulate design specifications and evaluation criteria; determining methodologies and performing solution analyses	1	1	1		1						1
3	Develop skills in project management including organization, teamwork, planning, scheduling, and budgeting			1	1	1					1	1
4	Develop skills in library techniques such as literature and information searching							1		1	1	1
5	Develop technical writing and oral communication skills through proposal and report writing, as well as mid-course and final presentations					1		1				1
6	Ability to design and conduct experiments and analyze data	1	1	1								1
7	Understanding of professional and ethical responsibility						1					1
8	Obtain a general understanding of engineering economics, marketing, career strategies, and resume preparation.						1		1	1		1
9	Understand the impact of engineering solutions in a global and societal context								1			1
10	Knowledge of contemporary engineering issues									1	1	1

<u>List of Topics</u>

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

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

1. A Clear Technical Design Objective and the Project Contract
2. Experiment Design and Feasibility Study
3. A Detailed Design Specification
4. Global, Economic, Environmental and Societal Impact
5. Contemporary Engineering Issues
6. Test Plan
7. Understanding of Professional and Ethical Responsibility
8. Recognition of the need for and an ability to engage in lifelong learning
9. Design Review Presentation
10. Detailed Quantitative Design and Prototype
11. Test Report
12. Final Presentation
13. Working Demo and Final Report

CS10: INTRODUCTION TO COMPUTER SCIENCE FOR SCIENCE, MATHEMATICS AND ENGINEERING I

Lecture: 3 hours; laboratory 3 hours

Prerequisite(s): MATH 009A (may be taken concurrently), First Year Calculus. Introduction to the differential calculus of functions of one variable.

Instructor: In the last five years, the following instructors have taught this class: Kris Miller

Text book(s):

- Big C++, Cay Horstmann and Timothy Budd

Course Objectives with Mapping to Student Outcomes:

Objective Outcome Matrix													
Objective Addresses Outcome: 1-slightly 2-moderately 3-substantially													
Outcome Related Learning Objectives	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
Use variables to store computer program data	2	0	0	0	0	0	0	0	3	2	0	0	0
Form and use mathematical and Boolean expressions of variables	3	0	0	0	0	0	0	0	3	3	0	0	0
Process program input and generate program output	1	0	2	0	0	0	0	0	3	1	2	0	0
Use branches to create programs incorporating decision making	1	0	2	0	0	0	0	0	3	1	2	0	0
Use loops to create programs that repeat certain behaviors	1	0	2	0	0	0	0	0	3	1	2	0	0
Use functions to modularize programs	1	0	2	0	1	0	0	0	3	1	2	0	0
Use arrays to store collections of data	1	0	2	0	0	0	0	0	3	1	2	0	0
Use strings to handle textual data	1	0	2	0	0	0	0	0	3	1	2	0	0
Use classes as a record that keeps related data together	1	0	2	0	0	0	0	0	3	1	2	0	0
Convert a problem description into a set of about 50-100 computer instructions	3	0	3	0	0	0	0	0	3	3	3	0	0
Debug programs written by oneself or by others	3	0	0	0	0	0	0	0	3	3	0	3	0
Understand very basic methods of testing a program	3	0	0	0	0	0	0	0	3	3	0	2	0
Incorporate useful comments into programs	0	0	0	0	1	0	0	0	3	0	2	0	0

Catalog Description:
Structured and object-oriented programming in C++, emphasizing good programming principles and development of substantial programs. Topics include recursion, pointers, linked lists, abstract data types, and libraries. Also covers software engineering principles.

Requirement Status: Required

CS61: Machine Organization and Assembly Language Programming

Lecture: 3 hours; laboratory 3 hours

Prerequisite(s): MATH CS 005 or CS 010: Introduction to Computer Science for Science, Mathematics and Engineering I. Solving problems through structured programming of algorithms on computers, using the C++ object-oriented language. Topics include variables, expressions, input/output (I/O), branches, loops, functions, parameters, arrays, strings, file I/O, and classes. Also covers software design, testing, and debugging; or knowledge of programming or consent of instructor.

Instructor: In the last five years, the following instructors have taught this class: Brian Linard, Frank Vahid, and Harry Hsieh.

Text book(s):

- Introduction to Computer Systems, 2nd Edition, Patt & Patel (McGraw Hill), ISBN 0-07-24267509

Course Objectives with Mapping to Student Outcomes:

Objective Outcome Matrix													
Objective Addresses Outcome: 1-slightly 2-moderately 3-substantially													
Outcome Related Learning Objectives	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
Represent numbers in different bases, including decimal, hexadecimal, and binary, and perform arithmetic on such numbers	2	0	1	0	0	0	0	0	3	2	1	0	0
Understand the basic combinational and sequential digital logic components as they relate to understanding the basic parts of a computer, including registers and arithmetic-logic units	2	0	1	0	0	0	0	0	3	2	1	0	0
Understand how computer instructions work for a simple computer addressing modes	2	0	1	0	0	0	0	0	3	2	1	0	0
Understand the von Neumann model of computing	2	0	1	0	0	0	0	0	3	2	1	0	0
Understand how computer instructions use memory, including different	3	0	1	0	0	0	0	0	3	3	1	1	0
Know how interrupts interact with regular computer execution	2	0	3	0	0	0	0	0	3	2	3	0	0
Understand modes of input/output	0	0	0	0	1	0	0	0	3	0	0	0	0
Understand the roles of assemblers and linkers	3	0	2	0	0	0	0	0	3	3	2	3	0

Understand how some Higher Level Language constructs are built in assembly language	2	0	3	0	0	0	0	0	3	2	3	0	0
Write assembly language programs of 100-200 instructions	1	0	0	0	0	0	0	0	3	1	0	3	0

Catalog Description:
An introduction to computer organization. Topics include number representation, combinational and sequential logic, computer instructions, memory organization, addressing modes, interrupt, input/output (I/O), assembly language programming, assemblers, and linkers.

Requirement Status: Elective

CS161: DESIGN AND ARCHITECTURE OF COMPUTER SYSTEMS

Lecture: 3 hours; **Discussion**: 1 hour

Prerequisite(s): CS 120B/EE 120B: Introduction to Embedded Systems. Introduction to hardware and software design of digital computing systems embedded in electronic devices (such as digital cameras or portable video games). Topics include custom and programmable processor design, standard peripherals, memories, interfacing, and hardware/software tradeoffs. Laboratory involves use of synthesis tools, programmable logic, and microcontrollers and development of working embedded systems; concurrent enrollment in CS 161L.

Instructor: In the last five years, the following instructors have taught this class: Philip Brisk and Walid Najjar.

Textbook(s):

- Computer Organization and Design, The Hardware/Software Interface, 4th Edition, John L. Hennessy and David A. Patterson, Morgan Kaufmann Publishers, 2009

Course Objectives with Mapping to Student Outcomes:

Objective Outcome Matrix													
Objective Addresses Outcome: 1-slightly 2-moderately 3-substantially													
Outcome Related Learning Objectives	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
Understand instructions as the language of the machine and the tradeoffs in instruction set design	1	1	1	0	0	0	0	0	3	1	2	1	0
Introduction to the issues and factors that impact performance, both hardware and software	2	1	2	0	0	0	0	0	3	2	2	2	0
Learn how to design the data-path and control unit as the heart of the CPU	3	0	3	0	0	0	0	0	3	3	3	2	0
Introduction to computer arithmetic: fast addition and Multiplication	3	2	3	0	0	0	0	0	3	3	3	0	0
Introduction to memory hierarchy: simple caches and virtual memory	2	2	3	0	0	0	0	0	3	2	3	2	0

Catalog Description:
A study of the fundamentals of computer design. Topics include the performance evaluation of microprocessors, instruction set design and measurements of use, microprocessor implementation techniques including multi-cycle and pipelined implementations, computer arithmetic, memory hierarchy, and input/output (I/O) systems.

Requirement Status: Required

CS161L: LABORATORY IN DESIGN AND ARCHITECTURE OF COMPUTER SYSTEMS

Lecture: 1 hours; **Laboratory**: 3 hours

Prerequisite(s): CS 120B/EE 120B; concurrent enrollment in CS 161

Instructor: In the last five years, the following instructors have taught this class: Phillip Brisk and Walid Najar.

Textbook(s):

- Computer Organization and Design, The Hardware/Software Interface, 4th Edition, John L. Hennessy and David A. Patterson, Morgan Kaufmann Publishers, 2009

Course Objectives with Mapping to Student Outcomes:

Objective Outcome Matrix													
Objective Addresses Outcome: 1-slightly 2-moderately 3-substantially													
Outcome Related Learning Objectives	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
Understanding of computer arithmetic by (1) Design and implementation of an ALU and (2) Implementation of complex arithmetic algorithms in software.	3	1	3	0	0	0	0	0	3	3	2	0	0
Understanding of operation of a CPU by (1) Design and implementation of a data-path and (2) Design and implementation of a the control unit both for the MIPS architecture	3	1	3	0	0	0	0	0	3	3	3	0	0
Understanding of operation of a cache memory by designing and writing a cache-simulator program in C/C++	3	1	2	0	0	0	0	0	3	3	2	0	0
Familiarity with the cycle-level simulation of a complex computer architectures	1	0	0	0	0	0	0	0	3	1	0	0	0
Understanding of data-paths via a hands on introduction to data-paths	3	0	0	0	0	0	0	0	3	3	0	0	0

Catalog Description:
Students design and simulate a complete computer system, using hardware description language and simulator. Topics include instruction set architecture design, assemblers, data-path and control unit design, arithmetic and logic unit, memory and input/output (I/O) systems, and integration of all parts into a working computer system.

Requirement Status: Required

ENGR 180W COURSE SYLLABUS

Class Name: Technical Communication

Instructors: Sharon Burton and Bonni Graham
Contact info:
Sharon email: sharon@anthrobytes.com or
Sharon Yahoo IM only: sharonvburton
Bonni email: bgraham@manuallabour.com
Bonni Yahoo IM only: esotericabjg

Class Policies

Each student is responsible for the following policies.

1. Cheating is **not** allowed in this class. **Any** cheating at **any** time will result in an **F** for the entire class and further action as defined by the University.
2. All assignments must be turned into the Moodle site (located at http://moodle.cs.ucr.edu) by the assignment specific deadline. All assignments **must** be named as follows:
   [labperson][studentfirstlastname][assignmentname].[extension]
   For example: Bonni**SBurtonVarkEssay.doc**
   After the first week, incorrectly named assignments will **not** be graded and the student will receive a **zero** for that assignment.
   Assignments in non-acceptable electronic file formats will **not** be graded. Acceptable file formats are:
   - doc
   - pdf
   - rtf
   - zip
   - ppt
   - txt
3. Failure to adequately complete each assignment can result in failure for this class. It is the student's responsibility to understand the requirements of the assignment, complete the assignment, and upload the assignment to Moodle by the specified deadline.
4. Assignments, including reading assignments, will be explained in lecture and lab. It is the students' responsibility to attend lecture and lab for this information.
5. Based on the instructor's evaluation, a student may be required to work with the UCR writing lab on each assignment. If the student is required to do so, the student must provide a signed note from the writing lab that each assignment was reviewed with a tutor in the writing lab before the assignment can be graded. There are no exceptions to this decision.

Textbooks

A Guide to Writing as an Engineer. Beer and McMurrey 2009
Reading assignments to be determined and assigned in class

Websites

Course website: http://moodle.cs.ucr.edu - all course material will be on this site

Course Goals and Objectives

1. Ability to participate and contribute to discussions and meetings, both in leading and nonleading roles.
2. Ability to make cogent, well-organized verbal presentations, with and without visual aids prepared via presentation software.
3. Ability to produce cogent, well-written documents (including email).
4. Understanding of professional and ethical responsibility, particularly regarding well-designed human interfaces including documentation.
5. Understanding of what is expected in the professional workplace, including the need for long-term professional development.Major Topics Covered in the Course

Importance of communication in science and engineering, defining an audience, organizing and drafting documents, technical writing standards, revising for organization and style, developing graphics, conducting meetings, memos/letters/email, proposals, progress reports, articles, instructions and procedures, electronic text, oral presentations, job search documents.

Also: inductive and deductive reasoning, truth tables, presentation style and skills, VARK, use cases, mind maps, grammar and style, writing functional specifications, usability testing, explanations and simplification, visual gestalt in design, designing for online use, and ethics in communication.

Oral and Written Communications

Every student is required to submit at least 15 written reports (not including exams, tests, quizzes, or commented programs) of typically 2 to 5 pages and to make 1 oral presentation of typically 5 minutes duration.

Social and Ethical Issues

Ethical implications of poor communication are discussed. Students are required to produce high-quality documentation and to rewrite poor documentation using the standards taught in lecture and reading.

Ethical implication of design and audience awareness are discussed, and students are required to demonstrate this awareness in each unit project which is designed for different audiences: management, peers, end users. Social awareness of audience and the implications of technology are discussed. Projects are required to demonstrate said awareness.

Theoretical Content

Students are expected to understand critical thinking & logic as is applies to writing, and to synthesize that with other topics.

Students are exposed to a variety of design & layout theories, including visual gestalt, and expected to discuss these topics not only theoretically, but articulate practical applications as well (~4-6 hours lecture, scattered throughout course)

Students are exposed to cognitive processing and learning theory, and how it applies to interfaces and documentation (4-6 hours lecture, scattered throughout course)

Grading

50% written exams covering theory and writing, 30% homework, 10% presentations, 10% participation.

Students are checked off on work completed in labs, are graded on drafts, revisions, and completed documents, and take quizzes and exams that have multiple choice and essay questions.

Students are graded by at least the following standards: following the assignments, writing ability, logical argument, and the principles covered in class and in the reading assignments.

ENGLISH 1A

Fall Quarter 2011

Instructor: Wallace Cleaves Section: (012)
Email: Wallace.Cleaves@ucr.edu Classroom: INTS 2134
Office: HMNSS 2002 Class Time: TR 9:40-11:00 am
Office Hours: TR 9:00-9:30 am & 11:10-11:45 am (Wed. by Appt.)

Required Texts

• ***The St. Martin's Guide to Writing (ninth edition).*** by Rise B. Axelrod and Charles R. Cooper. (2010)

• ***Into the Wild.*** by Jon Krakauer. (1996)

Course Description

English 1 A focuses on developing your basic writing skills and your proficiency with the essay format to prepare you for college level writing assignments. You will learn to read critically, think analytically, and write with rhetorical awareness of a particular writing situation's audience, purpose and genre conventions. You will become familiar with the complete composition process, including invention, planning, drafting, revising, proofreading, and editing. You will also perform research (including field research, library and internet research) and learn how to appropriately document sources. This course is designed to help you become metacognitive, critically aware of your own thinking and writing process.

Course Requirements and Rules

• Attendance is Mandatory! **Class Participation** affects your grade.

•Always **bring your texts** to class, especially the ones from which your current readings were assigned. Also, always bring paper and a pen or pencil.

• **Quizzes** are not scheduled, and may be given any day. They will be given in the first 10 minutes of class and can not be made up (yet another reason to take attendance seriously). Quizzes will reflect material from the assigned readings and class discussion.

•You will be have both an in class **Midterm** and a **Final** for this course. The location of the Final will be announced later in the quarter. You will need to bring a Blue Book and pen for both of these exams.

• **Papers**, **Drafts** and **Worksheets** must be turned in at the beginning of class on the day they are due. All papers must also be submitted to Safe Assign through the Class link on Blackboard / i-learn. All papers will be penalized one grade for each day they are late. Not having or not fulfilling the requirements of a **Draft** or **Worksheet** will cost a paper one whole grade.

•All Papers must be typed on 8½ x 11 paper with 1-inch margins, double-spaced, and in a 10-12 point standard font. This includes First Drafts. Please staple your papers together before class. Follow the MLA System of Documentation found on pages 766-778 of The St. Martin's Guide to Writing. Also refer to the example paper on pages 787-794 to see how a final draft should look.

•Plagiarism is a serious offense that will result in failure of the assignment. A report of the infraction will be sent to Student Conduct. See their website at www.conduct.ucr.edu for more information.

Grading

This class requires you to write **4 Papers** of increasing sophistication and length. You will also be required to take an in class essay **Midterm** and **Final**. In addition to this there will be **Quizzes** based on the assigned readings, and your daily **Class Participation**, all of which will be taken into account for your grade as follows:

Paper # 1	10%
Paper # 2	10%
Paper # 3	15%
Final Paper # 4	20%
Midterm – In Class Essay	10%
Final	15%
Quizzes	10%
Class Participation	***10%***
Total	100%

The titles of the two course texts are abbreviated in the course schedule. SMG stands for The St. Martin's Guide to Writing (ninth edition), and ITW stands for Into the Wild.

How to read the Schedule: Each day the course meets is listed below. The "In Class" information tells you any assignments that are due (these are noted in **Bold Face** type), any special instructions, and a general idea of what we will cover that day. The "Readings" information tells you what reading assignments you will be responsible for having read **BEFORE** the class session. For example, when you attend class on Tuesday, September 27th, I will expect you to have read pages 14-63 of The St. Martin's Guide to Writing.

English 1A – Fall 2011 – Course Schedule (tentative)

Week Zero

Thursday, September 22 Reading: SMG "Preface" p. xxi-xxxiii & "Introduction" p.1-12
In Class: Introduction to the Course

Week One

Tuesday, September 27 Reading: SMG Ch 2 "Remembering an Event" p.14-63
In Class: Discuss First Paper – also your First Quiz!

Thursday, September 29 Reading: SMG Ch 14" Narrating" p.615-627 & Ch 15 "Describing"p.628-638
In Class: Choosing Your Event

Week Two

Tuesday, October 4 Reading: SMG Ch 11 "A Catalogue of Invention Strategies" p.562-574
In Class:. Paper # 1 Workshop and Draft Session

Thursday, October 6 Reading: SMG Ch 12 " A Catalog of Reading Strategies) p.575-598
In Class: **Paper # 1 Due**

Week Three

Tuesday, October 11 Reading: SMG Ch 3 "Writing Profiles" p.64-125
In Class: Introduction of Paper # 2

Thursday, October 13 Reading: SMG Ch 20 "Field Research" p.716-727 & Online Profile # 1
In Class: Profile Plan Workshop & Introduce *Into the Wild*

Week Four

Tuesday, October 18 Reading: ITW 3-37 & Online Profile # 2
In Class: Introduce *Into the Wild* & Discuss Paper # 2

Thursday, October 20 Reading: ITW 38-97
In Class: **Paper # 2 Due -** Discuss *Into the Wild*

Week Five

Tuesday, October 25 Reading: ITW 98-132 & SMG "Essay Examinations" p.814-831
In Class: Viewing of the film *Into the Wild*

Thursday, October 27 Reading: ITW 133-171
In Class: Viewing of the film *Into the Wild*

Week Six

Tuesday, November 1 Reading: SMG Ch 4 "Explaining a Concept" p.126-183
In Class: Discuss Paper # 3 & Viewing of the film *Into the Wild*

Thursday, November 3 Reading: ITW 172-203
In Class: **Midterm in Class Essay- Bring a Blue Book** Topic Workshop

Week Seven

Tuesday, November 8 Reading: SMG Ch 16 "Defining" p.639-646 & Ch 17 "Classifying"p.647-652
& SMG Ch 21 "Library and Internet Research" p.728-754
In Class: Library Session - Organizing and Structuring Writing Assignments

Thursday, November 10 Reading: SMG Ch 18 "Comparing and Contrasting" p.653-658
In Class: Draft Workshop for Paper # 3

Week Eight

Tuesday, November 15 Reading: Online Concept Examples (See Course Ilearn Site)

In Class: Discuss the Wiki Concept
Thursday, November 17 Reading: SMG Ch 5 "Finding Common Ground" p.184-243
In Class: **Paper # 3 Due** & Discuss Final Paper and Organize Debates

<u>Week Nine</u>
Tuesday, November 22 Reading: SMG "Two Debates" p.243-263 & Ch 19 "Arguing" p.659-672
In Class: <u>Debates Workshop</u>
Thursday, November 24 Reading: SMG “Oral Presentations” p.838-842
In Class: **Thanksgiving Holiday - No Class**

<u>Week Ten</u>
Tuesday, November 29 In Class: Debates
Thursday, December 1 In Class: Debates & Review for Final Exam

<u>Final Exam</u> - December 5, 11:30am-2:30 pm - Location to be announced - **Final Paper Due at Exam**

ENGLISH 001B.058

Composition II
Winter 2010

T/R, 8:10-9:30 am — Ray Crosby
HMNSS 1405 — raymond.crosby@email.ucr.edu

Instructor Office Hours:
HMNSS 2300: T/R: 4-5pm; R: 9:40-10:40 am (after class); or by appointment
Online (iLearn chat): W: 9-10pm

Course Materials:
- St. Martin's Guide to Writing: 8th Ed. (Eds. Axelrod and Cooper)
- Tortilla Curtain by T.C. Boyle

Course Description:
English 1B, the second in the three semester 1A/1B/1C series, introduces students to argumentation. Students will learn to support arguments, address possible objections, and develop responsible research strategies. This course approaches writing as a process that includes elements of invention, drafting, revising, and editing, and classroom activities are designed to develop these skills through individual assignments, small group work, and peer review. In addition, students will learn to be better critical readers as they become better writers.

Attendance and Participation:
Your success in this course depends on regular attendance and active participation. Please understand that English 1B is not a lecture class where you can get notes for classes you've missed or easily make up coursework. This is a writer's workshop that requires your presence and constructive participation, and many of the in-class activities cannot be made up. Attendance will be taken daily and the St. Martin's Guide will be used regularly, so please bring this book to class every session. Attendance factors into course grading in various ways, and failure to attend class regularly may result in a failure of the course.

Blackboard and iLearn:
This course will make heavy use of the online Blackboard system, which is located at iLearn.ucr.edu. You will submit your essays electronically through Safe Assignments, can access additional course materials posted or linked to the site, and may be expected to post messages on the Blackboard periodically. Check the site regularly because important instructions for completing assignments, as well as class announcements and helpful links, will appear there. Log into the Blackboard site using the same username and password that you use for UCR Webmail (campus computing can assist you if you find you have difficulties with this).

Class Etiquette and Decorum:
1. It is expected that you will participate appropriately and as adults in class and online discussions. We are a diverse academic community, representing different faiths, lifestyles, ethnicities, sexualities, and cultures. In addition, we will be discussing controversial issues—

issues that typically elicit strong opinions, so it is especially important that you will be tolerant, respectful, and considerate of your fellow classmates during any discussions.
2. Please turn off all cell phones, iPods, etc. before entering the classroom. Laptop computers are not to be used during the class.

Readings:
Reading and the ability to write well are inextricably linked. With this in mind, you will be expected to read the assigned material and come to class prepared to discuss the reading. You may also be assigned writing activities to be brought to class or posted on Blackboard.

Quizzes:
Each Tuesday we will have a short grammar review and quiz during the first few minutes of class based on the suggested readings from the St. Martin's Guide Glossary. These quizzes cannot be made up (so get to class on time and ready to go). There will also be a reading quiz at the end of Week 3 on the novel Tortilla Curtain. Other pop quizzes on the readings may be given at the instructor's discretion.

Essay Assignments:
All out-of-class essay assignments should follow MLA format. This means they must be typed, doubled-spaced, with 1-inch margins all around, in a 12 point font. The first page must display the student's name, the teacher's name, the class number and title, and the assignment's due date. Every paper should have an original title. Consult the St. Martin's Guide or the professor for any questions on MLA format.
1. There will be four out-of-class essay assignments for the course and several in-class and Blackboard writing assignments.
2. All four out-of-class essays (#1: Arguing a Position, #2: Proposing a Solution, #3: Justifying an Evaluation, and #4: Speculating about Causes) must be submitted through Safe Assignments on Blackboard.
3. Because English 1B is focused on the Writing Process, all invention work, rough drafts, peer critiques from workshops, revisions, and copies of research materials (when applicable) must be submitted as a "packet" with the final draft in order to receive credit. If these materials are not included, the paper will be returned with a grade of "incomplete" and will be treated as a late paper until it is resubmitted with the appropriate documents.
4. Each out-of-class essay and "packet" will also be paired with a short in-class metacognitive essay (to be written during the class period when the essay and "packet" are turned in), reflecting on the writing process involved in constructing and revising the essay.
5. Failure to complete any of the essay assignments (including the out-of-class essay, in-class metacognitive essay, or "packet") will result in failure of the course. It is important to learn to write in each of the genres, so you must submit each essay.
6. Finally, you will be responsible for peer critiques during class, which means that you will respond to the work of other students and offer meaningful feedback to help them make their essays as effective as possible.

Plagiarism and Academic Misconduct:
Plagiarism is the "copying of language, structure, or ideas of another and attributing (explicitly or implicitly) the work to one's own efforts. Plagiarism means using another's work without

giving credit. Examples include but are not limited to: (1) copying information from computer-based sources, i.e., the Internet, and (2) allowing another person to substantially alter or revise your work and submitting it entirely as your own" (http://conduct.ucr.edu/). Please familiarize yourself with the MLA guidelines for proper citation on the iLearn site. In order to discourage plagiarism, all University Writing Program students are required to submit their essays on Safe Assignments through iLearn. If you are found to have plagiarized, you may receive a zero on the assignment and an "F" for the course. Further disciplinary action may also be taken by the Student Conduct & Academic Integrity Program (SCAIP). If you ever have a question about plagiarism or about whether or not you might be plagiarizing in a particular essay, please ask me before the essay is due.

Final Exam:
The final exam for this course will be an additional essay focused on the novel Tortilla Curtain. We will not meet for a physical exam, but it will be a take-home final centered on this essay.

Grading Policy:
1. All essay assignments will be graded on the basis of how well they meet the requirements of the assignment. That means that students must utilize all of the basic features discussed in the appropriate chapter of the St. Martin's Guide and will be graded accordingly.
2. The following will be the breakdown of the grades in the course:

Essay #1 (Arguing a Position) & "Packet"	10%
Essay #2 (Proposing a Solution) & "Packet"	15%
Essay #3 (Justifying an Evaluation) & "Packet"	20%
Essay #4 (Speculating about Causes) & "Packet"	20%
In-class Metacognitive Essays (4)	10%
Attendance, In-class Activities, Quizzes, and Participation	15%
Final Exam	10%

3. This grading scale is subject to the stipulation that, regardless of overall percentage, failure to complete and submit a major assignment (including the four essays, "packets," and in-class metacognitive essays) will result in a course failure.
4. A passing grade in English 1B is a C or better (C- or below is a fail and necessitates repeating the course).

Late Work:
All essays must be submitted via Safe Assignments on Blackboard by the start of class on the due date. All of your invention work, drafts, and peer critiques must also be turned in as a "packet" on the due date. If you have a personal emergency or other extenuating circumstances that prevent you from finishing your assignment on time or turning in your essay as scheduled, email or see me as soon as possible so we can discuss your situation. I may accept late work, but it will be penalized: one-third of a letter grade will be deducted each day (weekdays and weekends) that the paper is not turned in.

Class Drops:
You may withdraw before the end of week 3 (the add/drop period) without penalty. If you wish to drop between week 4 and the end of week 6, you may withdraw with penalty. After week 6, you can only drop the class by petitioning your Dean for a retroactive withdrawal, which will be approved only for medical or other documented reasons and will not be given if you are failing the course.

Disabilities / Special Needs:
If you have a physical, psychiatric/emotional, medical, or learning disability that may impact your ability to carry out assigned course work, I urge you to contact the staff in Student Special Services (http://specialservices.ucr.edu/) who will review your concerns and determine, with you, what accommodations are necessary and appropriate. All information and documentation are confidential.

1B TR WINTER 2010 SCHEDULE
Abbreviations: The St. Martin's Guide to Writing (SMG), Tortilla Curtain (TC)

	Tuesday	Thursday
	1/5	1/7
Week 1	Introductions	Read: SMG 274-83, 294-95 Write: Finding an Issue to Write About (297-8), Exploring the Issue (299)
	1/12	1/14
Week 2	Read: SMG 283-93, 670-85 Write: Developing Your Argument (301), Outlining (307-08) Glossary: H-5-10 ("S": Sentence Boundaries)	Read: SMG 319-21 Essay #1 Rough Draft / Peer Review
	1/19	1/21
Week 3	Essay #1 and Packet due	TC Quiz Read: SMG 328-41, 360-61 Glossary: H-11-29 ("G": Grammatical Sentences) Write: Finding a Problem to Write About (363-65), Analyzing and Defining the Problem (365)
	1/26	1/28
Week 4	Read: SMG 341-59 Write: Finding a Tentative Solution (366-67), Offering Reasons for Your Proposal (369) , Considering Alternative Solutions (369) Glossary: H-30-46 ("E": Effective Sentences)	Read: SMG 386-67 Write: Doing Research (370), Outlining (374-75)
	2/2	2/4
Week 5	Essay #2 Rough Draft /Peer Review	Essay #2 and Packet due

Glossary: H-47-56 (“W”: Word Choice)
2/9 2/11
Week 6 Read: SMG 396-407, 422-23 Read: SMG 407-13

Write: Finding a Subject to Write About (425-26) , Exploring Your Subject and Possible Readers (426-27)

Glossary: H-57-84 (“P”: Punctuation) Write: Becoming an Expert on Your Subject (428-29), Developing Your Evaluation (429)
2/16 2/18
Week 7 Read: SMG 414-21, 446-49 Essay #3 Rough Draft / Peer Review

Write: Outlining (434)

Glossary: H-85-103 (“M”: Mechanics)
2/23 2/25
Week 8 Essay #3 and Packet due Read: SMG 456-65, 482-83

Glossary: H-104-14 (“L”: ESL Trouble spots) Write: Finding a Subject to Write About (485-88), Considering Causes (489)
3/2 3/4
Week 9 Read: SMG 465-81
Read: SMG 508-09
Write: Researching Your Subject (490), Researching Causes (492)

Glossary: H-115-31 (“R”: Review of Sentence Structure) Write: Outlining (497-98)
3/9 3/11
Week 10 Essay #4 Rough Draft / Peer Review Essay #4 and Packet due

Glossary: H-132-38 (“GL”: Frequently Misused Words)
Note: it is the instructor’s prerogative to adjust the course schedule throughout the quarter

(Detach here)
- -

Student Agreement

I have read and understand the syllabus for English 001B.058 and agree to follow the course policies.

______________________________________ __________________________________
Signed Date

CHEM001A GENERAL CHEMISTRY

SYLLABUS Fall, 2009

Department of Chemistry University of California, Riverside
Lee Wilson

You are responsible for familiarizing yourself with all material (11 pages) in this syllabus .

A. TENTATIVE LECTURE SCHEDULE AND EXAMINATION DATES

CHEMISTRY 001A, Section 040 Fall, 2009

(Lecture weeks/days assigned to specific chapters are subject to modification).

Week #	Date	Ch.	Topic	Suggested Problems*	
0	24-SEP	1	Definitions, changes, micro&macro, using units , sig figs	5, **6, 26, 30, 33, 36, 39, 41, 42, 58**	(1)
1	29-SEP	1, 2	Atoms, Mass laws Atomic Theory, Isotopes(Z,A)	**62, 66, 69, (2)**14, **20**, 27, **29,** 33, **41**	(2)
1	1-OCT	2	Isotopes (cont.), Symbols Periodic Table (PT)	**43,** 47, **50**, 53, **57,** 58, **63**, 64, **71**	(3)
2	6-OCT	2	PT(cont.), Bonding, Formulas,	72, **74**, 76, **77**, 78, **84**, 87, **91,**	(4)

			Names	94	
2	8-OCT	2	Names & Formulas (cont.) Finish Ch.2	**96,** 98, **99,**102, 103, 114, **119,** 1**31,** 148, 155	(5)
3	13-OCT	3	Mole, Molar mass,	**9, 11, 12, 17, 21, 33, 35**, 37	(6)
3	15-OCT	3	Conversions, Formulas	41, 46, 51, **54**, 55, **64, 65, 67**	(7)
4	20-OCT	3	Equations, Stoichiometry	**72,** 73, **76, 81, 85, 98, 99,100**	(8)
4	22-OCT		Exam 1 Chs. 1,2, 3 (part)		
5	27-OCT	3, 4	Stoichiometry (cont.), Molar, Solutions	**101,** 103, **105, (4)** 10, 13, **17,** **18**	(9)
5	29-OCT	4	Solution preparation Stoichiometry	**21,** 29, 32, **35, 48,** 49**, 52**	(10)
6	3-NOV	4	Aqueous Solutions, Precipitation Acid-Base, Redox	**53, 65, 66, 74**, 78, 91, 95, 99	(11)
6	5-NOV	4, 6	Redox (cont.), Energy, Heat, Work, Enthalpy	10, **15,** 25, 36, **37, 43**, **52, 58**	(12)
7	10-NOV	6	Rxns, Stoichiometry, Hess Standard Enthalpies (ΔH°)	66, 67, 71, **78**, **80,** 82, **86**	(13)
7	12-NOV	6,7	ΔH°(finish), Wavelength, Frequency, Spectra	8, **10, 11, 12**, 15, 20, **23**	(14)
8	17-NOV		Exam 2	Chs. 3 (part), 4, 6, 7(part)	
8	19-NOV	7	Spectra,Rydberg, Bohr, Duality, de Broglie,	**27,** 29, **42, 43, 49, 51**	(15)
9	24-NOV	7	QM, orbitals (s,p,d,f,), Shape	**56, 58,** 59, 64,**73**	(16)
9	26-NOV		Thanksgiving Vacation		
10	1-DEC	8	Periodic Table(PT), e^- configs	9,**11,**18, **21, 24, 28, 33, 48**	(17)
10	3-DEC	8	e- configs, Orbital diagrams	57, 65, 70, **75,** 80, **83, 89**	(18)

11 **9-DEC 11:30- 14:30** ***<u>FINAL EXAM</u> {* NOTE- THERE ARE <u>NO</u> EXAM MAKE-UPS AND THE FINAL EXAM IS MANDATORY FOR PASSING THE CLASS}*** **Room to be announced.**

Homework: CHEMISTRY IS NOT A SPECTATOR SPORT. WE LEARN BY DOING, PRACTICING.

*** Suggested Problems** are from the corresponding chapter in Silberberg, 5th Ed, for that class period. Example: For the 24-SEP line the 5, **6, 26, 30, 33, 36, etc.,** means do chapter 1, problem 5 (1.5), chapter 1, problem 6 (1.6) , 1.26, 1.30,1.33,1.36,1.39, etc.

Problems in **bold** type are to be done on the ARIS class website. This will be your homework grade. **<u>You will have at least three days to do each assignment</u>**. Problems in plain type are recommended.

Many ARIS problems are algorithmic, that means they have same procedure to solve the problem but different numbers to use. Answer might be different from what someone else gets! You can try a problem as many times as you wish. Then you my try the assignment again, and again! Would be good for you to go over the problem before you do it on the ARIS website.

Instructions for registering for and using ARIS will be given in Course Materials in ilearn.

B. LABORATORY

The laboratory performance (grade) is not included in the lecture grade. However, the subject matter is coordinated. Lecture exam questions may refer to examples from the laboratory experiments.

NOTE: FAILURE TO ATTEND THE FIRST LAB MIGHT RESULT IN THE LOSS OF YOUR POSITION IN THAT LAB SECTION!

C. <u>COURSE DESCRIPTION, LOCATION, TIME:</u>

PREREQUISITES: CHEM 001W or MATH 005 (or a "C" grade or better in an equivalent course or a passing score on the California Chemistry Diagnostic Test).

LECTURE: Chemistry 1A meets for three 50 minute lectures a week. Topics include elements, computation using units, atomic structure, periodic table, chemical formulas, naming, chemical equations, stoichiometry, redox, solutions, energy and chemical reactions, wave nature of atoms, atomic orbitals, and electron configurations.

DISCUSSION SECTIONS: At registration **a** student is assigned to a discussion section (sections 41 to 53) which meets for one 50 minute period a week under the tutelage of a Teaching Assistant (TA). Homework type problems will be discussed and a quiz will be given. See SchedLectDiscussF09.doc file in **ilearn.ucr.edu** for section times, rooms and TA's.

CLASSROOM: BRNHL B118

CLASS TIME: 12:40 – 14:00 TR

D. <u>COURSE PERSONNEL</u>

LECTURE INSTRUCTOR: LEE WILSON
Office Hours: 11:00 – 12:30 & 14:10-15:00 TR and by appointment.
Office: 1136 Pierce Hall, (951)-827-6232 (office), (951)-785-4060 (home)
E-mail: leland.wilson@ucr.edu

FACULTY ACADEMIC COORDINATOR: KEVIN SIMPSON, Ph.D.

Office: 1309A Pierce Hall; (951)-827-3539
Email: kevin.simpson@ucr.edu

TEACHING ASSISTANTS:
See SchedLectDiscussF09.doc file in **ilearn.ucr.edu**.

E. **MATERIALS**

* Required materials are marked with an asterisk.

*1.**Textbook**: Silberberg, *Chemistry*, 5th Ed. (McGraw-Hill) 2009.
*2. This syllabus (AVAILABLE FROM CLASS INSTRUCTOR or over internet).
*3. ScanTron Test Grading Forms: Form 888 (full page) midterms; Form 882 (narrow) final.
4. Other materials that go with the textbook are available in the book store. These include a solutions manual, and a study guide. Recommended but not required.
5. **Supplemental Material:** The UCR Blackboard website (ilearn) may contain lecture notes, sample exams, quiz and exam scores, cumulative scores, final grades, announcements and other useful information. This material may be downloaded and printed. Use http://www.ilearn.ucr.edu for instructions on getting **username** and **password**.
6. Calculators: A simple, scientific (exponential and logarithms) calculator (~$10) is all that is needed. During exams programmable calculators must be reset and no Palm Pilot types may be used.

F. **GRADING POLICY AND EXPECTATIONS**:

Letter Grades: *Approximately*, grades will be earned as follows.

90% or greater	A-, A, A+
between 80% and 90%	B-, B, B+
between 60% and 80%	C-, C, C+
between 50% and 60%	D-, D, D+
below 50%	F

Approximate Weights (% of total)	
Exam 1 (80 minutes)	18
Exam 2 (80 minutes)	18
Final Exam (3 hours)	36
Quizzes	18
Homework	10
Total	100

A 90% total guarantees **at least** an A- grade. It could be higher.

The “weights” may vary a few points, but total is still 100. Any changes will be to the advantage of the overall class. These are the weights in the grade book on **ilearn.ucr.edu**. Because of built in extra credit on exams it is possible to get more than 100 points total!

Curve? Grades are **not** based on the “normal curve”. That would mean a certain fraction would get A, another fraction get B and so on. That is not how grades are earned in this class. All could get an A or an F. DO THE BEST YOU CAN, DO NOT EXPECT AN *A* OR *B* JUST BECAUSE YOU THINK YOU ARE DOING BETTER THAN MOST OF THE OTHER CLASS MEMBERS. The top grade could be in the B range. Often, grades are similar to those earned under a “curved” system.

Exam adjustment: If your % score on your final exam is higher than on each midterm your total exam score will be adjusted upward. The adjustment will be calculated as follows.

Adjustment = 18*(final% - lowest midterm%)/100

The 16 is the weight of the midterm.

Attendance:

Lecture-It is wise (but not required as per University policy) for you to attend each lecture. However, the sample quizzes might help you on quizzes given in your discussion section.

Discussion Section- It is strongly suggested that you attend your assigned discussion section. Homework problems will be discussed and a quiz given at each session. The quiz scores will count on your overall grade. There are **no** make up quizzes. *Exams*- **You must attend all exams**.

Examinations:

You Must be present for exams and SHOW student ID card. No make up exams are given except for extremely extenuating circumstances. The class schedule on page 2 is tentative only; exam days may be changed (except for final).

Two midterm exams (80 min) and one final exam (180 min) will be given. Each may contain some objective type questions (SCANTRON marking), workout problems and essay questions. FAMILIARIZE, DON”T MEMORIZE. The emphasis is on understanding and familiarity; not memorization. You must show your reasoning, not just answers on workout problems. The use of units and significant figures is required.

Sample exam questions may be available on the BlackBoard web site; solutions might not be provided. You learn by figuring out the answers. However, if you do not know how to work it out you may contact the instructor for help. Answers to examination questions will be posted on Blackboard (ilearn.ucr.edu) after the exam. **You will be able grade the exam yourself!**

Seating: Seats will be assigned and posted (ilearn.ucr.edu) for exams.

Quizzes: Short quizzes based on homework will be given at the discussion sections. THERE ARE NO MAKEUP QUIZZES. One lowest quiz will be dropped.

Homework: As mentioned in page 3, many of the suggested homework problems are to be done in ARIS. This will constitute your homework grade. Instructions for ARIS are in the Course Materials section of the class website on ilearn.

Cheating: Cheating should not be a viable consideration or action, it is unfair. However, so there is no misunderstanding, I refer you to the "Academic Discipline Process" as passed by the Faculty of UCR in 1988. This Document is on file in the Office of the Vice Chancellor, in Student Services, and in the Academic Senate Office, 2334 Library South. ***IN SHORT: KEEP YOUR EYES ON YOUR OWN PAPER DURING QUIZZES AND EXAMS; USE ONLY AUTHORIZED MATERIALS DURING QUIZZES AND EXAMS.***

G. COMMUNICATION:

Memoranda on classroom blackboards and on the BlackBoard website, ilearn.ucr.edu, will inform you of important items of interest and/or changes in the general class operation. If you are not in class the instructor is not obligated to repeat the communication at a later time.

Exam keys, quiz and exam scores will be posted on the BlackBoard website, ilearn.ucr.edu.

This website contains lecture outlines, notes, sample exams, quiz and exam scores, cumulative scores, final grades, announcements and other useful information. This material may be downloaded and printed. Use http://www.ilearn.ucr.edu for instructions on getting **username** and **password**.

Contact the instructor around class time, at office hours, or by phone or e-mail (use your UCR e-mail address or your real name). See Personnel section. Also contact the TA's during office hours. ASK QUESTIONS ON CONTENT IN CLASS.

H. HELPS AND SUGGESTIONS.

HOW TO PASS THIS CLASS: (Many of you will be familiar with the following points. Thanks to Drs. Simpson and Wirz.)
NOTE: It is YOUR responsibility to learn. The instructors will do everything within reason to help the subject matter make sense. BUT, YOU have to do the studying. PLAN (BUDGET) your time. LEARN BY DOING. DO HOMWORK PROBLEMS TO TEST AND INCREASE YOUR UNDERSTANDING . ***FAMILIARIZE, DON'T MEMORIZE.***
1**. Join or help form a Study Group:** When you help someone else understand something you simultaneously help yourself. *You are not competing directly (no" normal curve") for a grade, so do not hesitate to study with others.* **The Learning Center, 1st floor Surge Building, sponsors CHEM 1A Supplemental Instruction (SI) study groups sessions. These sessions are conducted by undergraduates who have done well in the class and attend the lectures. Announcements will be made in class. Studies have shown that SI participants obtain higher grades (half to a whole letter) than non-participants.**

2. **Do suggested problems for every class period**. "Chemistry is not a spectator sport." You must practice regularly. LEARN BY APPLYING and DOING. That is how you familiarize yourself with the ideas, procedures, the ways of thinking about chemistry. Those exercises should be the minimum number attempted. If you do problems with a study group make sure YOU understand each problem yourself. Discussing things with others helps you understand.

3. **Read in the textbook about the daily topic (see pages 2 & 3) BEFORE class**. Do it for EVERY class period; otherwise, it will be difficult to catch up. ALSO, look over the corresponding material on the CD-ROM that comes with the text.

4. **Take notes during the lecture.** If the instructor is going too fast do not hesitate to ask for clarification. The lecture period will include a list of things to be discussed that day, an opportunity to ask questions, a review to make a connection from old to new material and an explanation of the new material. The bulk of the lecture notes will be on ilearn.ucr.edu before class. You can print them out in note taking format from PowerPoint.

5. **Ask questions if you do not understand the direction or main points in the lecture.** It is quite likely that many others will not understand either; they will appreciate your asking questions. Raise your hand or speak up. If you do not want to ask a question directly, you may write it on a half sheet of paper and turn it in at the end of the lecture. See Minute Papers described above. The instructor will return it to you the next class period.

6. **Go over your notes and material as soon as possible after the class.** You can start doing that mentally before you put pen or pencil to paper. Also outline the chapter in your own words so that it makes sense to you.

7. **Use the supplementary material** such as the Study Guide and the Partial Solutions Guide.

8. **Contact the Instructor and Teaching Assistants during office hours.** That information will be posted in the hall outside the student laboratories. Outside of office hours the instructor may be contacted at 785-4060. Please call before 22:00. DO NOT PUT OFF GETTING HELP ON THE LECTURE OR LABORATORY MATERIAL UNTIL YOU ARE TOO FAR BEHIND. MAKE USE OF THE INSTRUCTOR AND TEACHING ASSISTANTS. We are here to serve you.

9. **Let the instructor and TA know as soon as possible w**hen there are problems of any kind - car break down, illness, personality conflicts, and so on that will affect attendance & performance.

10. **You are responsible for any handouts presented during the quarter**. If you miss a handout or announcement because you decide not to attend class on a given day, it is not the Instructor's responsibility to make certain you are informed.

11. **Make a habit of checking the class BlackBoard (ilearn) website** for information that may be placed there. We will try to inform you by email.
REMEMBER: MOST QUESTIONS ABOUT CLASS ORGANIZATION AND PROCEDURES ARE ANSWERED IN THIS SYLLABUS. LITTLE SYMPATHY IS GIVEN TO THOSE WHO FAIL TO FOLLOW PUBLISHED PROCEDURES AND POLICIES

***************** ***IMPORTANT NOTES*** *********************

1. ***MAKE-UP EXAMS ARE NOT ALLOWED. IF YOU MISS A MID-TERM EXAM AND HAVE A VALID, SUBSTANTIATED EXCUSE, AND HAVE PROPERLY NOTIFIED ME***

WITHIN A REASONABLE TIME, I WILL GIVE YOU A MAKE UP FOR THAT EXAM. IF YOU ARE VERIFIABLY ILL BEFORE THE EXAM, AND KNOW YOU ARE LIKELY TO MISS THE EXAM, PLEASE NOTIFY ME IN ADVANCE OF THE EXAM TIME.

2. DESIGNATED SEATING (SEATING CHART) AND PICTURE IDENTIFICATION WILL BE REQUIRED FOR EXAMINATIONS.

****

I. REVIEWS FOR EXAMS (Thanks to Drs. Kevin Simpson and Don Wirz)

<u>Chapter 1</u>

1. Familiarize self with relationships amongst elements, compounds, and mixtures. Fig. 1.16
2. Be able to use the number of sig figs in calculations. In "chain" calculations keep one more sig fig than justified until get to final answer.
3. Familiarize self with SI units and prefixes: mega, kilo, JULi, centi, milli, micro, pico, and nano
4. Do calculations using units and show how they cancel to leave desired units. You do not have to memorize relations amongst units, just know how to use and where to find them.

<u>Chapter 2</u>

1. Familiarize self with names and symbols of elements. PRACTICE, DO NOT ROTE MEMORIZE. Look at periodic table (PT) and practice giving name for the symbol elements in first four periods as well as those in Groups 1, 2, 10, 11, 12, 14, 17, and 18.
2. Write and interpret nuclide symbols, e.g, ${}^{35}_{17}Cl$, in terms of neutrons, protons, and electrons.
3. Understand and (calculate) atomic mass (in PT) as average over the isotopic masses.
4. Be able to classify compounds as likely to be ionic or molecular.
5. Familiarize self with the common ions in Tables 2.5 and 2.6 so that you can make the transformation: **name ↔ formula.** PRACTICE, DO NOT ROTE MEMORIZE. PRACTICE DAILY FROM NOW ON SO YOU CAN GET FAMILIAR WITH THE LANGUAGE OF CHEMISTRY. Be able to use ROMAN numerals (-ous and –ic are of lesser importance). Be able to predict charge of *monatomic* ion from PT group.
6. Be able to balance equations by inspection in a systematic way.

Chapter 3

1. Given a formula be able to calculate formula mass (weight). Interpret in terms of mass of one formula unit (amu) and one mole (grams).
2. Be able to make transformation: **mass $\leftrightarrow$ moles**. Of course need the chemical formula.
3. Be able to determine EMPIRICAL formula from percentage composition and vice versa.
4. Be able to convert from mass of A to mass of B (or C or D) using mole relationships in formula or chemical equation. Figure 3.11. USE UNITS! **SO IMPORTANT to be able to do these calculations from now on!** Mass A $\rightarrow$ Mole A $\rightarrow$ Mole B $\rightarrow$ Mass B
5. Determine limiting Reagent and theoretical yield.
6. Know and use definition of molar concentration to get moles and vice versa.
7. Here is a problem involving the determination of Avogadro's number. Given: 0.5000 gram of Ag(s) can be plated out in 1.000 hour by passing a current of 0.1243 ampere through a Ag^{+1} solution. One ampere is one coulomb/sec. One electron has a charge of $1.602*10^{-19}$ coulomb. The relation between number of electrons and atoms is given by Ag^{+1}(aq) + 1 e^{-1}(in electrode) $\rightarrow$ Ag(s).
Find: Number of coulombs used, number of electrons involved, number of moles of Ag atoms made and then Avogadro's number (it has units of 1/mol).

Chapter 4-

1. Familiarize self with solubility rules (IONIC) so can classify reaction as involving precipitation.
A short list of rules for solubility follows. *NOTE: order is important*. 1. Group one and ammonium ions compounds are soluble compounds. 2. Nitrates and acetates are soluble. 3. Most chlorides, bromides, iodides, and sulfates soluble. 4. Most carbonates, phosphates, sulfides, oxides and hydroxides are insoluble.
The exceptions to # 3 and #4 are NOT important to remember for now.
2. Familiarize self with classifying strong and weak acids and bases so can classify reaction as involving acids and bases (neutralization). Strong acids are $HClO_4$, $HClO_3$, H_2SO_4, HNO_3, HCl, HBr, HI. *List is small so you can learn them, easily*. Note that last three involve halogens. Strong bases, Group 1 and Group 2 (Ca^{+2}, Ba^{+2}, Sr^{+2}) (except for $Mg(OH)_2$, which is so insoluble it is used as "Milk of Magnesia") hydroxides.
3. Familiarize self with oxidation number assignments so that can classify reactions as involving redox. A short list of rules for assigning oxidation numbers follows. *NOTE: order is important*. 1. Uncombined elements (eg, He, O_2, O_3, Fe, Na, I_2) have oxidation number of zero. 2. In a compound, Group 1 elements have +1 as oxidation number. Note: H is –1 in NaH otherwise it is +1. 3. F is –1. 4. The sum of oxidation numbers is equal to the net charge on the specie. Consequently, O is –2 in Na_2O and H_2O , O is –1 in Na_2O_2, O is –1/2 in NaO_2. 5. In binary oxygen compounds oxygen (with above exceptions) is –2. Note that in ClO_4^{-1} applying rule 4 and 5 means Cl is + 7. Applying rules 2 and 4 Cl has –1 in HCl or NaCl.
4. Be able to balance redox reactions by the half reaction (ion-electron) method. Write and balance each half rxn for atoms, then for charge and then combine so # electrons gained = # electrons lost. Identify oxidizing and reducing *agents*. PRACTICE, PRACTICE, PRACTICE.
5. Know concentration definition of molarity, M (mol/L soln). Apply using mass, molar mass, and volume of solution. Do dilution calculations using: moles initially (before dilution)= M_iV_i = M_fV_f = moles finally (after dilution).

PRACTICE, DON'T EVEN TRY TO ROTE MEMORIZE.

Chapter 6-

1. Familiarize self with energy units and forms of energy, kinetic, potential, work, heat, internal.
2. Recognize that reactions are accompanied by energy changes that can be in form of heat and/or work.
3. Be are aware of energy change sign conventions based on *system* and *surroundings*. Viewpoint is from the system. *Positive* if going *into* system. Energy ***into*** the system (+) is like money ***into*** your pocket.
4. Be able to combine reactions to get an overall reaction and combine enthalpy changes in same way.
5. Be aware that enthalpy *change* is heat measured at constant temperature and pressure.

Chapter 7-

1. Understand relationship amongst wavelength(λ), frequency(ν) and speed (c); $\lambda\nu$=c.
2. Recognize particle nature of light revealed by work of Planck and Einstein. Duality.
3. Recognize wave nature of matter suggested by de Broglie and affirmed by Davisson and Germer. Duality.
4. Note that electrons are described by functions (called orbitals). Each function is described by a set of three numbers (quantum numbers) symbolized by n, ℓ, and m.
5. Relate the quantum numbers to orbital appearance.

Chapter 8 (Part) –

1. Use the PT to write electron configuration in spdf and box and arrow (orbital diagram) representations. PT is best way to know how to remember the order used in the Aufbau principle.
2. Use Hund"s Rule for arranging electrons in subshells. Relate results to magnetic properties.

CHEMISTRY 1A - GENERAL REVIEW SUGGESTIONS FOR FINAL EXAM.

1. Questions approximately evenly distributed over all 8 chapters.
2. The exam may have between 40 to 75 multiple choice questions. There may be some workout problems.
3. Chapter 1. Units, conversion factors, sig figs.
4. Chapter 2. Naming, writing formulas, general features of PT, writing and balancing equations.
5. Chapter 3. Classify compounds as to ionic or molecular. Use solubility rules, acid-base ideas and oxidation numbers to classify rxns as to precipitation, acid-base neutralization or redox. Be able to balance redox rxns by half-rxn method.
6. Chapter 4. Be able to calculate molecular mass (amu and grams) and molar masses, convert mass to moles and vice versa, convert moles of A to moles of C, determine formula from mass percentage, use molar concentrations to get moles.
7. Chaper 6. Be able to combine rxns to get an overall rxn and corresponding enthalpy change.

8. Chapter 7. Convert between frequency, wavelength and speed for electromagnetic radiation, calculate energy of a photon and mole of photons, apply Bohr model to explain spectrum of H atom, calculate de Broglie wavelength, describe wavefunctions (orbitals) with quantum number sets.
9. Chapter 8. Apply orbital concepts to writing electron configuration and orbital diagrams for elements and ions using the periodic table.
10. You will be given constants, and most of the major equations. Concentrate on understanding the application of theory and how to use the equations. Try to put your whole one quarter of chemistry knowledge into use. Be logical and think reasonably. ***ABOVE ALL - DO NOT GIVE IN TO PANIC. START YOUR STUDYING NOW. HAVE CONFIDENCE IN YOURSELF AND YOUR CAPABILITIES.***

CHEMISTRY-01LA: GENERAL CHEMISTRY LABORATORY

Fall 2009
GENERAL DESCRIPTION

Chemistry 01LA consists of one three-hour laboratory per week. If you have not previously completed the lecture, CHEM-001A, you are required to be enrolled in both courses concurrently, as the material covered in lab is directly related to the lecture topics.

INSTRUCTIONAL PERSONNEL

Your lab section is directly supervised by a Teaching Assistant (TA). Please check the "Faculty Information" section on iLearn for the names and contact information of your TA and other instructional personnel.

REQUIRED COURSE MATERIALS FOR CHEMISTRY 01LA LABORATORY

1. Laboratory Manual: CHEM 1LA/1HA Laboratory Manual, 2009-10 Edition, (Hayden-McNeil Publishing Company, ISBN: 978-0-7380-3353-5). This is available in the UCR bookstore or University Book Exchange.
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2. Student Lab Notebook, spiral-bound with carbonless duplicate pages (Hayden-McNeil Specialty Products, ISBN: 1-930882-74-2). This is available in the UCR bookstore.
3. Lab Apron or Lab Coat (recommended – required if you wear shorts or a short skirt, etc.). If you wear an apron or lab coat, it must be extend to within one foot of the floor. Short coats or aprons will not be allowed in lab. Lab aprons may be checked out from the stockroom.
4. A "scientific" hand calculator with exponential and logarithm functions. Graphing, programmable, or text memory calculators with multi-line readout are ***not allowed for use on lab quizzes*.**

CHEM-01LA Laboratory Schedule
Fall 2009
Week
Beginning
Experiment
Manual
Pages
Prelab
Exercise
1 September 28 Check-in; Introduction; Laboratory Safety;
Science Library Orientation & Exercises
v-ix;
73-84
—
2 October 5 *Experiment 1 – Densities of Liquids and Solids*; Quiz #1 (which will cover Safety and *Experiment 1*)
1-10;
85-91;

95-98
9-10
3 October 12 *Experiment 2 – Paper Chromatography*;
Quiz #2; Library Exercises due October 12
11-20
19-20
4 October 19 *Experiment 3 – Water of Hydration*; Quiz #3 21-30;
86
29-30
5 October 26 *Experiment 4 – The Alkaline Earths and*
Halogens; Quiz #4
31-41
41
6 November 2 *Experiment 5 – Molar Mass of a Solid Acid*;
Quiz #5; Wednesday sections turn in report #5
by 9:00 pm Tuesday, November 10.
43-51;
89-98
51
7 November 9 *Experiment 6 – Calorimetry*; Quiz #6; No labs
on Wednesday, Nov. 11 due to Veteran's Day
holiday. Wednesday students will perform the
experiment on Nov. 25
53-60 59-60
8 November 16 *Experiment 7 – Emission of Light from Hydrogen*
and Metal Atoms; Quiz #7; check-out;
report due at the end of the period
61-72 71-72
9 November 23 *Wednesday Sections only*
Experiment 6 – Calorimetry; Quiz #6; Report
due at end of the period; no labs on Monday,
Tuesday, or Thursday
53-60 59-60
10 November 30 Comprehensive Lab Final Exam; *Experiment*
7 Report will be returned
v-ix;
1-102
—

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LABORATORY POLICIES

Grading. Grading will largely be based on seven lab experiments, which are worth 30 points each as detailed below:

4 points *Prelab Exercise* (from the laboratory manual)
2 points *Purpose* and experimental *Procedure* (in outline form)
3 points *Data* and observations (2 pts) / laboratory technique (1 pt)

12 points *Report*; the Report must include filled-out Report Sheets, and
page(s) of calculations from your lab notebook
3 points *Results and Conclusion* section (written in your lab notebook)
6 points *Quiz*; given at the beginning of each lab period, the quiz may
cover material related to the current and previous experiments
Points assigned to laboratory technique will be based on your mastery of proper lab techniques (including laboratory safety) as evaluated by your Teaching Assistant. Points will be deducted from in-lab data/laboratory technique for poor lab technique, failure to follow safety rules, etc. as determined by your TA. To be considered satisfactory, your work for each experiment must include all of the above listed components. *Note that you must have your TA sign the Data page(s) in your notebook and turn in a copy at the end of the period in order to receive any credit for the experiment.*
In addition to the seven experiments, there is a final exam (30 points) and a series of library exercises (10 points). The final exam is comprehensive, covering material from all seven lab experiments. The library exercises consist of an orientation to the science library, conducted during the first week of lab, and follow-up exercises which are accessed by logging in to the iLearn website for this lab section. *The library exercises must be completed by October 12.*
Your course grade will be based on your total points (250 possible), computed according to the following scheme:
A+ : 235 points
A : 225 points
A- : 215 points
B+ : 210 points
B : 205 points
B- : 195 points
C+ : 185 points
C : 165 points
C- : 140 points
D+ : 130 points
D : 120 points
D- : 110 points
F : less than 110 points
NOTE: two or more unexcused absences from lab will result in a grade of "F", regardless of your total number of points.
4
What is required in your notebook for each experiment?
For each experiment you must include the following 5 sections in your laboratory notebook. You will retain the original pages in your notebook and turn in the carbonless duplicate pages (marked "COPY") to your Teaching Assistant.
1. Purpose
2. Procedure (in outline form)
3. Data (measurements and observations recorded in your lab notebook)
4. Calculations (written in your lab notebook)
5. Results and Conclusion; this section includes these two components:
a. Error Analysis
b. Conclusion

Below is an explanation of what needs to be in each section.

1. Purpose - the purpose of the experiment should a succinct statement of the main point of the lab. It should not be more than 2-3 sentences long.

2. Procedure - a step-by-step procedure in the form of an outline. Do not write the procedure in paragraph format. The outline should brief and to the point, including only the level of detail necessary for you to carry out the experiment. In most cases the purpose and the procedure should fit on one notebook page. Refer to the example on page 76 in the lab manual.

Turn in the copy of the notebook pages containing the Purpose and Procedure to your TA at the beginning of the period.

3. Data – Begin a new page and record all your measurements and observations in a table format (see example on page 77 in the lab manual) and underneath the table write any observations or comments pertaining to the experiment. Use the whole page for this. You might find it useful to set up the data table before coming to lab. Do not include calculated values in the Data section. ***At the conclusion of each lab period you must get your TA's signature (in the "Witness/TA" box at the bottom) on each of the Data pages in your lab notebook and turn in the copy.***

4. Calculations - on a new page following the Data, show sample calculations of all the important calculations leading to the final results of the experiment. If you did multiple trials, use only the first trial to show the set-up of the calculations. Keep in mind that in some instances you will be asked by the TA to show sample calculations of all the trials. The duplicate notebook pages containing the Calculations are attached to your Report sheets and turned in the following week.

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5. Results and Conclusion. This section must include these two components. The duplicate pages from your notebook are to be attached to your Report sheets and turned in the following week.

a. Error Analysis - If your final results were not what was expected, then use this section to describe what went wrong and to give any possible sources of error. For example, suppose you performed three titrations to determine the molarity of an acid solution and one of the titrations resulted in a value of the molarity significantly different than the other two. If you noticed halfway through one titration that there was an air bubble in the tip of the buret, you would discuss what effect this might have on the accuracy of your results.

b. Conclusion - In no more than 3 to 5 coherent sentences state your final conclusions of the lab **BASED on your experimental results.** Most importantly you want to answer the question: "**Did I accomplish the purpose of this experiment?**" and if so, you must relate **how you accomplished the purpose** by stating your final results. For example, if the purpose of the experiment was to determine the concentration of a base by titration with an acid, your conclusion should state the average concentration of base, and assess the precision of your results by providing the standard deviation of your trials. Moreover, in your conclusion you should present one or two new ideas that were learned by doing the experiment. Please keep your conclusion short and to the point and keep it separate from the error analysis.

Refer to Appendix A (p. 73-77) and Appendix B (p. 79-80) of the lab manual for additional information about the laboratory notebook and preparation for laboratory. The table on page 80 summarizes the various parts of a complete experiment, and when each part is due.

Late Assignments. All laboratory assignments (*Prelab Exercise*, *Purpose & Procedure*, and *Laboratory Report*) are due at the beginning of your lab period. An assignment is considered to be late if it is not turned in by the time your TA begins the lab quiz. Late assignments will not be accepted. Furthermore, you will not be allowed to perform the experiment nor will you be given the opportunity to make up the lab if your *Prelab Exercise* and/or *Purpose & Procedure* are not completed by the beginning of the lab period.

Laboratory Final Exam. The final exam for the laboratory portion of the course is scheduled for
the regular lab period during the week of November 30. It will consist of 15 multiple-choice questions pertaining to the lab experiments and related background topics. You must take the final during your regularly scheduled lab day and time in order to pass the course.

Attendance. You must check in to your lab section during the first week or you may lose your space. It will not be possible to make up missed laboratory experiments. If you must miss a lab period due to medical or other legitimate reasons, you must contact Dr. Simpson (kevin.simpson@ucr.edu; (951) 827-3539) immediately to make arrangements for making up the quiz and turning in the other assignments. Be prepared to provide a doctor's note or other acceptable documentation. *NOTE: a maximum of one absence from lab will be excused during*
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the quarter. Two or more unexcused absences will result in a grade of "F", regardless of the total number of points you have accumulated.

Cheating. Cheating will not be tolerated. Students caught cheating will receive a zero grade for the experiment and will be subject to dismissal from the class with a failing grade. Cheating includes (but is not limited to) collaborating on assignments without approval from the instructor, turning in a report without performing the experiment, interfering with another student's work, and removing chemicals, equipment or glassware from the laboratory. If you are repeating the course, you may not reuse any data or reports from any previous time you took this course. Also, you will not receive credit for any lab for which you fail to provide a copy (signed by your TA) of your notebook data page(s).

Course Website (iLearn). A website for this laboratory section may be accessed by logging in at http://ilearn.ucr.edu. You are expected to check this site frequently, as important announcements and course materials may be posted there. Your lab scores and final grade will also be posted on iLearn.

Laboratory Safety. The instructors and staff place the highest priority on your safety. To this end, you are required to understand and follow the safety precautions and rules that are printed below and in your lab manual (pages v-ix). In addition, you may be given specific instructions for each experiment and you are expected to follow these. The most basic safety requirement in lab is that **goggles are to be worn at all times that experiments are in progress**. This means that even after you have finished the experiment, you are required to wear your goggles as long as any other person in the lab is still working. *NOTE: You may not bring food or beverages (even in closed containers) or wear sandal-type shoes in the lab.*

DEPARTMENT OF CHEMISTRY

LABORATORY SAFETY INSTRUCTIONS AND RULES

1. EYE PROTECTION: One of the most common (and damaging) types of laboratory accidents
involves the eyes.

EYE PROTECTION IS MANDATORY AT ALL TIMES IN ALL TEACHING AND

RESEARCH LABORATORIES. NO EXCEPTIONS. PERSONS WITH INADEQUATE EYE PROTECTION WILL BE TOLD TO LEAVE THE LABORATORY.

a. All persons in a laboratory must wear safety goggles.

b. Persons who normally wear prescription glasses must wear safety goggles over their glasses. Regular prescription glasses do not provide adequate protection for chemical laboratories.

2. PROPER ATTIRE: You will not be allowed in lab unless you are wearing clothing which completely covers the torso and legs (to within one foot of the floor). Shoes must completely enclose the foot. A lab coat or apron is recommended. You may wear shorts only under a full-length lab coat. For your protection, you will not be allowed to attend lab without appropriate attire.

3. MEDICAL CONDITIONS: Notify the supervising laboratory instructor immediately if you have any medical conditions (such as pregnancy, allergies, diabetes, etc.) that may require special precautionary measures in the laboratory.

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4. EMERGENCY EQUIPMENT: Know the locations of the lab fire extinguishers, safety showers, eyewash fountains, hallway emergency telephones, fire alarms, and lab and building exits.

5. FIRE: Immediately alert the TA, who will give instructions. A fire confined to a small container or flask can usually be extinguished by covering the container with something nonflammable (e.g. a large beaker). Use a fire extinguisher if necessary, but only if it appears that the fire can be easily contained; if not, pull the fire alarm and exit the building. Go directly to the designated assembly area. Do not use the elevator. If a person's clothing is on fire, use the safety shower to put out the flames. If the shower is not readily available, douse the individual with water or wrap the person in a coat or whatever is available to extinguish the fire and roll the person on the floor. Fire blankets must be used with caution because wrapping someone while they are in the vertical position can force flames toward the face and neck.

6. INJURY: Immediately report any injury to a Teaching Assistant, no matter how minor. The TA will initiate emergency procedures and arrange for transportation to a medical care facililty. Do not transport a seriously injured person. Call for help. Complete an Incident Report in consultation with your TA as soon as possible, and submit it to the Stockroom staff (see Item 7).

NOTE: The Student Health Center is open only during the day, from 8:00 – 4:30. Laboratory injuries after these hours will be treated at the Emergency Room at Riverside Community Hospital or a nearby Urgent Care Center. Students (or their health insurance company) will be assessed Emergency Room charges for off campus treatment. The Chemistry Department (or University) cannot pay. Students under 18 years must submit in advance, a treatment release form signed by parents or guardians to be held on file in the stockroom.

7. CHEMICAL SPILLS: Chemical contact with eyes and skin must be washed immediately with lots of water for no less than 15 minutes. USE THE EYE WASH AND SAFETY SHOWER. Quickly remove all contaminated clothing. Report chemical spills on persons, tables, or floors to a TA immediately regardless of how minor they appear.

8. EARTHQUAKE: Exit the laboratory if possible, but stay in the building and protect yourself from breaking windows or objects falling from above. When the quake subsides, quickly check, if possible, that all gas valves are closed and all electrical heating devices are turned off to stop reactions and prevent fires. Exit the building to the designated assembly area (see item 9). Do not use elevators.

9. BUILDING ALARM: Leave the building immediately and quietly to the designated assembly area, which is the grassy mall adjacent to the south wing of Pierce Hall and east of the bell tower (see map on the following page). Do not return until specifically told to re-enter. Note: Do not leave the building during active shaking from an earthquake.

10. REPORT OF INCIDENT: All incidents of fire, explosion, injury, or chemical spills (including mercury from broken thermometers) should be reported immediately to a TA. A written report is required after the incident; the stockroom has forms for filing written reports.

11. PREPARATION FOR LABORATORY: All students are expected to have read the experiment thoroughly prior to starting the lab work. Questions about procedures or precautions should be resolved by asking the TA or professor before the experiment. 8

12. ADDITIONAL LABORATORY RULES:

a. You may not bring nor consume any food or beverage in the laboratories. Smoking and application of cosmetics is not permitted in the labs.

b. You may not remove chemicals, equipment or supplies from the laboratories or stockrooms without written permission of the instructor, teaching assistant, or Laboratory Coordinator. Removal of any of the mentioned items will be treated as Academic Dishonesty and may result in a grade of F for the course.

c. Do not deliberately smell or taste chemicals.

d. Do not mix reagents unless you are instructed to do so or know the likely results.

e. Do not use unlabeled chemicals. Report them to the TA.

f. Never adulterate reagents by "pouring back" unused portions into stock bottles or using a contaminated pipet.

g. Do not dump chemicals into trash cans or sinks. Waste chemicals are to be disposed of in specially labeled containers only.

h. Extinguish matches with water and dispose of them in trash cans, never in the sinks.

i. Absolutely no horseplay of any kind is permitted in the labs.

j. Do not store chemicals in your lab drawer, unless specifically instructed to do so by your TA (e.g., when an experiment requires more than one lab period). All containers for storing chemicals must be clearly labeled (your name, experiment, and the full chemical name(s) of thecontents).

k. No visiting by friends is allowed during lab sessions. Pets or children are not allowed.

l. Do not drink water from lab faucets. This water may not be safe.

MATH 9A: FIRST YEAR CALCULUS

Textbooks: David Guichard: Calculus, Late Transcendentals. This is a free electronic book, available at http://www.whitman.edu/mathematics/calculus_late/

Analytic Geometry
 1.1 Lines
 1.2 Distance Between Two Points; Circles
 1.3 Functions
 1.4 Shifts and Dilations
Instantaneous Rate of Change: The Derivative
 2.1 The slope of a function
 2.2 An example
 2.3 Limits
 2.4 The Derivative Function
 2.5 Adjectives for Functions
Rules for Finding Derivatives
 3.1 The Power Rule
 3.2 Linearity of the Derivative
 3.3 The Product Rule
 3.4 The Quotient Rule
 3.5 The Chain Rule
Trigonometric Functions
 4.1 Trigonometric Functions
 4.2 The Derivative of sin x
 4.3 A Hard Limit
 4.4 The Derivative of sin x, continued
 4.5 Derivatives of the Trigonometric Functions
 4.6 Implicit Differentiation
 4.7 Limits revisited
Curve Sketching
 5.1 Maxima and Minima
 5.2 The First Derivative Test
 5.3 The Second Derivative Test
 5.4 Concavity and Inflection Points
 5.5 Asymptotes and Other Things to Look For
Applications of the Derivative
 6.1 Optimization
 6.2 Related Rates
 6.3 Newton's Method (Optional)
 6.4 Linear Approximations
 6.5 The Mean Value Theorem

MATH 9B: FIRST-YEAR CALCULUS

Textbooks: David Guichard: Calculus, Late Transcendentals. This is a free electronic book, available at http://mathdept.ucr.edu/pdf/Guichard-Complete.pdf

Integration
- 7.1 Two Examples
- 7.2 The Fundamental Theorem of Calculus
- 7.3 Some Property of Integrals
- 7.4 Substitution

Application of Integration
- 8.1 Areas between curves
- 8.2 Distance, Velocity, Acceleration
- 8.3 Volume
- 8.4 Average value of a function
- 8.5 Work

Transcendental Function
- 9.1 Inverse function
- 9.2 The natural logarithm
- 9.3 The exponential function
- 9.4 Other bases
- 9.5 Inverse Trigonometric Functions
- 9.6 Hyperbolic Functions

Techniques of Integration
- 10.1 Powers of sine and cosine
- 10.2 Trigonometric Substitutions
- 10.3 Integration by Parts
- 10.4 Rational Functions
- 10.5 Additional exercises

More Applications of Integration
- 11.1 Center of Mass
- 11.2 Kinetic energy; improper integrals
- 11.3 Probability
- 11.4 Arc Length
- 11.5 Surface Area

MATH 9C: FIRST YEAR CALCULUS

Textbooks:
Stewart: Single Variable Calculus 6th Edition
Infinite Sequences and Series
12.1
Sequences
12.2
Series
12.3
The Integral Test and Estimates of Sums
12.4
The Comparison Test
12.5
Alternating Series
12.6
Absolute Convergence and the Ratio and Root Tests
12.8.
Power Series
12.9
Representation of Functions as Power Series
12.10
Taylor and Maclaurin Series
12.11
Applications of Taylor Polynomials
Further Applications of Integration
9.1
Arc Length
9.2
Area of Surface of Revolution
Differential Equations
10.1
Modeling with Differential Equations
10.2
Direction Fields and Euler's Method
10.3
Separable Equations
10.4
Models for Population Growth
10.5
Linear Equations

MATH 10A: CALCULUS OF SEVERAL VARIABLES

Text: Vector Calculus, by Susan Colley

Chapter I, Vectors (6 lectures)
1.1 Vectors in Two and Three Dimensions
1.2 More about Vectors
1.3 The Dot Product
1.4 The Cross Product
1.5 Equations for Planes: Distance Problems
1.6 Some n---dimensional Geometry
1.7 New Coordinate Systems

Chapter 2, Differentiation in Several Variables (9 lectures)
2.1 Functions of Several Variables; Graphing Surfaces
2.2 Limits
2.3 The Derivative
2.4 Properties (of Derivatives); Higher order Partials
2.5 The Chain Rule
2.6 Directional Derivatives and the Gradient

Chapter 3, Vector Valued Functions (6lectures)
3.1 Parameterized Curves
3.2 Arclength
3.3 Vector Fields, An Introduction
3.4 Gradient, Divergence, Curl, and the Del Operator

Chapter 4, Maxima and Minima in Several Variables (6lectures)
4.1 Differentiation and Taylor's Theorem
4.2 Extrema of Functions
4.3 Lagrange Multipliers

Note--Instructors are urged to consider assigning a substantial number of the true/false problems that appear as a separate section at the end of each chapter.

The following "optional" parts of sections have been "left out"

"2.4 Newton's Method", "3.1--Kepler's Laws", "3.2--Differential Geometry"
The following "optional section" has been "left out"
4.4 Some Applications of Extrema

MATH 10B: CALCULUS OF SEVERAL VARIABLES

Text, Vector Calculus, by Susan Colley

Chapter 5, Multiple Integrals (10 lectures)
5.1 Introduction: Areas and Volumes
5.2 Double Integrals
5.3 Changing the Order of Integration
5.4 Triple Integrals
5.5 Change of Variables

Chapter 6, Line Integrals (7 lectures)
6.1 Scalar and Vector Line Integrals
6.2 Green's Theorem
6.3 Conservative Vector Fields

Chapter 7, Surface Integrals and Vector Analysis (10 lectures)
7.1 Parameterized Surfaces
7.2 Surface Integrals
7.e Stokes and Gauss's Theorem
7.4 Further Vector Analysis; Maxwell's Equations

Note – Instructors are urged to consider assigning a substantial number of the true/false problems that appear as a separate section at the end of each chapter.

Left out "Optional Sections"
5.6 Applications of Integration

MATHEMATICS 46: INTRODUCTION TO ORDINARY DIFFERENTIAL EQUATIONS

Text: Schaum's Outline of Differential Equations, 3ed, by Bronson and Costa.

An ebook and a Kindle edition are also available.

This is a course covering the standard basic material of differential equations. Topics covered include first order equations, linear second order equations, Laplace transforms and elementary applications to the physical and biological sciences.

TOPICS

	SUGGESTED NO. OF WEEK'S COVERAGE
Introduction, First Order Equations Chapters 1,2, 3, 4, 5, 6	3
Applications of First Order Equations Chapter 7	2
Linear Differential Equations Chapters 8, 9, 10, 11, 12	3
Initial Value Problems Chapter 13	1
Application of Second-Order Linear Differential Equations Chapter 14	1

PHYSICS 40A - GENERAL PHYSICS

Syllabus and Course Information

Web pages: The web pages for this course are on Blackboard: http://ilearn.ucr.edu/.
Communication: All communication will be done via Blackboard. Announcements, homework assignments, solutions, etc. will be available there. Check there ASAP, particularly for the first assignment.

Text: The required text is Physics for Scientists and Engineers, A Strategic Approach, 2nd Edition by Randall Knight, published by Pearson/Addison Wesley. Also available is the Student Solutions Manual. This is not required but will be helpful. It is also published by Pearson/Addison Wesley and can be obtained from various online bookstores. The publisher has provided an online site with interactive "ActivPhysics" demos.

Scope of the course: We will be covering chapters 1-12 in the book.

Chapter Topic

1 Concepts of Motion
2 Kinematics in One Dimension
3 Vectors and Coordinate Systems
4 Kinematics in Two Dimensions
5 Force and Motion
6 Dynamics I: Motion Along a Line
7 Newton's Third Law
8 Dynamics II: Motion in a Plane
9 Impulse and Momentum
10 Energy
11 Work
12 Rotation of a Rigid Body

This is 12 chapters, and the quarter is only 10 weeks long, so we will spend on average less than one week per chapter. However, some chapters are longer than others, so our schedule will vary.
Math: We will be using algebra, trig, calculus, and vectors rather freely - math is a tool, much like a language. It will be like taking literature in a foreign language, which up to now you have learned only in class. I realize that the math may be difficult. You must learn to be comfortable with it. I encourage you to take out your old math books and relearn the material if necessary. Without being comfortable with math, you will be lost.

Reading: The text will be required reading! I will expect that each of you comes to class prepared. The lectures will not be a substitute for reading the textbook. Instead, we will try to explore the physics together in class. Quizzes will be given to help motivate you do the reading. You can receive up to 5 bonus points from the quizzes which will be used to reduce the weight of the final exam.

Grading:

Quizzes - 5% Bonus
Lecture Participation (discussion questions) - 5%
Discussion Section Participation - 5%
Lab - 15%
Homework - 10%
Midterm Exam - 25%
Final Exam - 40%

Exams: the midterm is tentatively scheduled for Tuesday, Feb 14. It will be in-class, and will cover the material of the first half of the course. The final is scheduled for Thursday, March 22 from 8:00-11:00 AM, and will be held in Physics 2000 (same as the lectures). The final will cover all material in the course, with an emphasis on the later chapters. Both exams will contain a mix of "standard" problems as well as conceptual problems.

Discussion Sections: You should each enrolled in a discussion section which will be taught by one of our TAs. Attendance in discussion is mandatory and will account for 5% of your grade. There will be exercises in the discussion sections. The TAs will also man the Blackboard "Discussion" pages.

Labs: Labs are a required part of this course and count for 15% of your grade. They will be run separately and grades assigned from each of the sections will be passed on to me for inclusion into your final grade. Labs will start in the first week of the quarter, and run through the tenth week, for a total of 8 labs. (There are no labs the week of Jan 16 and Feb 20.) Please note that your lab grade may not be the one recorded in your lab book. We will have several lab TA's this quarter. Each TA grades slightly differently. Because of this, we normalize the lab grades for each section. So you will find that for some of you, the lab grade might be higher than what is in your lab book, while for others it will be lower.

Homework - using MasteringPhysics: There will be about 2 homework assignments per week. These will be done on-line using MasteringPhysics (http://www.masteringphysics.com). These should be complete by midnight (i.e. 11:59 pm) on the day they are due. If you do not already have a MasteringPhysics code, you may purchase one at the MasteringPhysics web site. Note: do NOT purchase a "MasteringPhysicsPlus" code as you will not be able to use it in this course. If you purchased your textbook at the University Bookstore, the code was included with the book. Once you have an account, you can enroll in this class. The class ID is MPCLARE40A12W.

Clickers: We will also be using the "Clicker" system. If you don't have a clicker, then you will have to buy one. They are only available at the campus bookstore. They cost approximately $50. If you already have one from another course, you don't need a new one. You must register your clicker ID at http://clickers.ucr.edu, also available at the "Clickers" link on the left sidebar. You must re-register each quarter, so please register as soon as the quarter begins. The clickers will be used for the reading quizzes, as well as for the discussion exercises.

While you will be given points for correct answers on the quizzes, only your participation will be graded for the discussion exercises. The point of the discussions is not to get the right answer immediately, but to be able to understand the concepts involved in coming to the correct answer. I will use the discussion questions also as starting points to see whether particular bits of physics need clarification.

Academic Resource Center: Drop-in tutoring will be available at the ARC (Surge Building, 1st floor) on either a drop-in or appointment basis. Tutoring should start in the middle of week 2.
A Final note: The purpose of this course, above all, is to help you to think. As such I am more interested in what you learn than anything else. Feel free to work together on assignments -- as long as you are learning. The caveat, of course, is that for the exams, which make up the majority of your grade, you are on your own.

PHYSICS 40B: GENERAL PHYICS

Text::"Physics for Scientists and Engineers" (2nd Edition) by Randall Knight

During the quarter we will cover Chapters 13-23 of the text. An approximate list of topics and lectures is listed below. Please note that this is only intended as a guide and we may diverge from this schedule, depending on class needs.

Lectures	Chapter	Sections	Topics
1-2	13	1-6	*Newtonian Gravity* *Gravitational Potential* *Satellite Orbits*
3-4	15	1-5	*Fluids* *Pressure* *Buoyancy* *Fluid Dynamics*
5-6	14	1-8	*Simple Harmonic Motion* *Energy and Dynamics* *Pendulum* *Damped Oscillations* *Driven Oscillations*
7-10	20	1-7	*Waves* *Sound and Light* *Power and Intensity* *Doppler Effect*
	21	1-8	*Superposition* *Standing Waves* *Interferenc e* *Beats*
11-17	16	1-6	*Solids, Liquids and Gases* *Temperature* *Phase Changes* *Ideal Gases*
	17	1-8	*Work and Heat* *First Law of Thermodynamics* *Thermal Properties* *Calorimetry* *Specific Heats* *Heat Transfer*

	18	1-8	*Molecular Speeds* *Pressure and Temperature* *Thermal Energy* *Second Law of Thermodynamics*
	19	1-6	*Heat Engines* *Refrigerators* *Efficiencies* *Carnot Cycle*
18-19	26	1-5	*Electric Charge* *Insulators and Conductors* *Coulomb's Law* *Field Model*

PHYSICS 40C: GENERAL PHYSICS

Calculus-based Physics course for physical sciences and engineering majors.

Recommended Text: *Fundamentals of Physics*, fifth edition
By Halliday, Resnick, and Walker: John Wiley & Sons Publishing
Chapters 24 through 33

Syllabus

<u>Topic</u>	<u>Lecture Hours</u>
1. Gauss' Law – Chapter 24	2.5
2. Electrical Potential – Chapter 25	2
3. Capacitance – Chapter 26	2
4. Current and Resistance – Chapter 27	2
5. Circuits – Chapter 28	3
6. The Magnetic Field – Chapter 29	2.5
7. Ampère's Law – Chapter 30	2
8. Faraday's Law of Induction – Chapter 31	5
9. Magnetism and Matter, Maxwell's Equations – Chapter 32	2
10. Electromagnetic Oscillations and Alternating Currents – Chapter 33	5
	Total: 28

Appendix B: Faculty Vitae

FERAS ABOU-GALALA
Lecturer, Department of Electrical Engineering

Education

Ph.D., Electrical Engineering, Ohio State University 2007
M.S., Electrical Engineering, Ohio State University, 2003
B.S., Electrical Engineering, University of Qatar, 2000

Academic Experience

Post-Doctoral Scholar, Department of Electrical Engineering, UCR 2007-2008
Department of Electrical Engineering, UCR 2008-Present Lecturer

Certifications or Professional Registrations

Microsoft Certified System Engineer
Green Building Associate

Current Memberships in Professional Organizations
Member of the Institute of Electrical and Electronics Engineers (IEEE) Jan 2001 – Present

Honors and Awards

Lecturer Professional Development Award, 2012

Service Activities

Committee member, Undergraduate Lower Division Curriculum Committee
Volunteer Soccer Coach, Boys & Girls Club of Columbus, Ohio
Volunteer Child Mentor, Children Uniting Nations Los Angeles

Selected Publications, Past 5 Years

F. Abou-Galala, B.L. Anderson, "Real-time all-optical performance monitoring using optical bit-shape correlation" *Applied Optics,* Vol. 48, issue 5, Jan 2009

F. Abou-Galala, Z. Xu, G. Chen, "Non-line-of-sight atmospheric channel modeling and validation in the solar blind ultraviolet regime" *SPIE Defense & Security conference proceedings,* vol. 6963-18, March 2008

Z. Xu, G. Chen, **F. Abou-Galala**, "Achievable data rates for ultraviolet communications through the atmosphere" *SPIE Defense & Security conference proceedings,* vol. 6963-10, March 2008

F. Abou-Galala, Z. Xu, “Fiber-based wide field-of-view optical antenna for non-line-of-sight wireless optical communication” *OFC/NFOEC conference proceedings*, February, 2008, submitted.

Zhengyuan Xu, G. Chen, **F. Abou-Galala**, M. Leonardi, “Experimental performance evaluation of non-line-of-sight ultraviolet communication systems, *SPIE Optics & Photonics, conf. proceedings*, vol. 6709, August 2007.

D. Rabb, B. L. Anderson, C. M. Warnky, **F. Abou-Galala**, "Binary White cell true time delay: demonstration of micro-blocks and folded lens trains as delay elements," *IEEE Journal of Lightwave Technology*, Vol. 24-4, pp. 1886-1895, April 2006.

NISSIM AMOS
Lecturer, Department of Electrical Engineering

Education

Ph.D., Electrical Engineering, UC-Riverside,	2008
M.S., Electrical Engineering, Florida International University,	2006
B.S., Electrical Engineering, Florida International University,	2004

Academic Experience

2011-Present: Assistant Research Professor, Department of Electrical Engineering UCR
2011-Present: Lecturer, Departments of Electrical Engineering and Materials Science and Engineering UCR
2009-2011: Postdoctoral Fellow, Department of Electrical Engineering UCR.

Current Memberships in Professional Organizations
- Applied Physical Society (APS)
- Institute of Electrical and Electronics Engineers (IEEE)

Honors and Awards
- Classified by the U.S. government as a scientist of "Extraordinary Ability" – granted permanent residency
- UCR – Chancellor's & College (Prestigious) Dissertation Fellowship
- US Air Force Office of Scientific Research (AFOSR) – undergraduate student fellowship
- FIU – Perry Graduate Scholarship & Dean's Merit Scholarship

Service Activities

Riverside CEO Forum

Selected Publications, Past 5 Years

N. Amos, E. Stefanescu, J. Butler, B. Lee, Y. Tian, R. Ikkawi, R. Chomko, V. L. Safonov, R. Haddon, D. Litvinov, and S. Khizroev, "Three-Dimensional Non-Volatile Magnetic Universal Logic Gates," J. Nanoelectronics and Optoelectronics. 6 (2), 132-137 (2011).
J. Hong, S. Niyogi, E. Bekyarova, M. Itkis, P. Ramesh, N. Amos, D. Litvinov, C. Berger, W. de Heer, S. Khizroev, and R. Haddon "Effect of Nitrophenyl Functionalization on the Magnetic Properties of Epitaxial Graphene," Small. 7, 1175-80 (2011).
J. R. Morales, N. Amos, S. Khizroev, and J. E. Garay, "Magneto-optical Faraday Effect in Nanocrystalline Oxides," J. Appl. Phys. 109, 093110 (2011).
B. Hu, N. Amos, Y. Tian, D. Litvinov, and S. Khizroev, "Study of Co/Pd Multilayers as a Candidate Material for Next Generation Magnetic Media," J. Appl. Phys. 109, 034314 (2011).
R. Fernandez, N. Amos, C. Zhang, B. Lee, and S. Khizroev, "Optimization of L10 FePt/MgO/CrRu Thin Films for Next-generation Magnetic Recording," Thin Solid Films. In Press (2011).

N. Amos, R. Fernandez, R. Ikkawi, M. Shachar, J. Hong, B. Lee, D. Litvinov, and S. Khizroev, "Ultra-High Coercivity Magnetic Force Microscopy Probes to Analyze High-Moment Magnetic Structures and Devices," IEEE Magnetics Letters 1, 6500104 (2010).

R. Fernandez, N. Amos, C. Zang, and S. Khizroev, "Microstructural Enhancement of High Coercivity L10-FePt Films for Next-generation Magnetic Recording Media," J. Nanoscience and Nanotechnology 11, 1-5 (2010).

N. Amos, A. Lavrenov, R. Fernandez, R. Ikkawi, D. Litvinov, and S. Khizroev, "High-resolution and High-coercivity FePt L10 Magnetic Force Microscopy Nanoprobes to Study Next-generation Magnetic Recording Media," J. Appl. Phys. 105, 07D526 (2009).

N. Amos, R. Ikkawi, R. Haddon, D. Litvinov, and S. Khizroev, "Controlling Multidomain Nanomagnetic States to Enable Sub-10 nm Magnetic Force Microscopy," Appl. Phys. Lett. 93, 203116 (2008).

S. Khizroev, R. Ikkawi, N. Amos, R. Chomko, V. Renugopalakrishnan, R. Haddon, and D. Litvinov, "Protein-Based Disk Recording at Areal Densities Beyond 10 Terabits/in2, MRS Bulletin. 33, 864-71 (2008).

N. Amos, R. Fernandez, R. Ikkawi, B. Lee, A. Lavrenov, A. Krichevsky, D. Litvinov, and S. Khizroev, "Magnetic Force Microscopy Study of Magnetic Stripe Domains in Sputter Deposited Permalloy Thin-Films," J. Appl. Phys. 103, 07E732 (2008).

R. Ikkawi, N. Amos, Y. Hijazi, D. Litvinov, and S. Khizroev, "Design, Fabrication, and Characterization of Near-field Apertures for 1 Tbit/in2 Areal Density," IEEE Trans. Mag. 44 (11), 1-4 (2008).

R. Ikkawi, N. Amos, A. Krichevsky, R. Chomko, D. Litvinov, and S. Khizroev, "Nanolasers to Enable Data Storage Beyond 10 Tbit/in2," Appl. Phys. Lett. 91, 153115 (2007).

N. Amos, A. Lavrenov, R. Ikkawi, P. Gomez, F. Candocia, R. Chomko, D. Litvinov, and S. Khizroev, "Nanomagnetic Probes to Image Patterned Media for Information Densities Beyond Ten Terabit-Per-Square-Inch," J. Nanoelectronics and Optoelectronics. 2, 202-204 (2007).

S. Khizroev, Y. Hijazi, N. Amos, E. Felissaint, N. Joshi, R. Ikkawi, R. Chomko, and D. Litvinov, "Physics of Perpendicular Recording with a Patterned Soft Underlayer," special information technologies issue, J. Nanoscience and Nanotechnology. 7, 1-12 (2007).

Selected Professional Development Activities

UC Export Control training in 2011

ALEXANDER A. BALANDIN
Professor, Department of Electrical Engineering

Education

Ph.D., Electrical Engineering, University of Notre Dame	1996
M.S., Electrical Engineering, University of Notre Dame	1995
M.S., Applied Physics, Moscow Institute of Physics and Technology	1991
B.S., Applied Mathematics, Moscow Institute of Physics and Technology	1989

Academic Experience

- Founding Chair (2006 – 2012), Materials Science & Engineering, University of California – Riverside (UCR), Riverside, California, USA
- Professor (2005 – present), Department of Electrical Engineering, University of California – Riverside (UCR), Riverside, California, USA
- Visiting Professor (2005 – 2006), Department of Engineering, University of Cambridge, Cambridge, United Kingdom
- Associate Professor (2001 – 2005) and Assistant Professor (1999 – 2001), Department of Electrical Engineering, University of California – Riverside (UCR), California, USA
- Research Engineer (1997 – 1999), Electrical Engineering Department, University of California – Los Angeles (UCLA), Los Angeles, California, USA
- Research Associate (1996 – 1997), Department of Electrical Engineering, University of Nebraska – Lincoln (UNL), Lincoln, Nebraska, USA
- Research & Teaching Assistant (1993 – 1996), Department of Electrical Engineering, University of Notre Dame (ND), Notre Dame, Indiana, USA
- Research Engineer (1991 – 1993), Moscow Institute of Physics and Technology (MIPT) and The Russian Space Agency (RSA), Moscow, Russia
- Research Assistant (1989 – 1991), Institute of Radio-Engineering and Electronics (IRE), Russian Academy of Sciences (RAS), Moscow, Russia

Non-Academic Experience

Consultant for several US high-tech companies

Certifications or Professional Registrations

n/a

Current Memberships in Professional Organizations

- Fellow of APS - The American Physical Society, 2012
- Fellow of IOP – The Institute of Physics, U.K., 2012
- Fellow of SPIE - The International Society for Optical Engineering, 2011
- Fellow of OSA - The Optical Society of America, 2011
- Fellow of AAAS - The American Association for Advancement of Science, 2007

Honors and Awards

- Pioneer of Nanotechnology Award, IEEE, 2011
- Semiconductor Research Corporation (SRC) Inventor Award, USA, 2009, 2010
- Distinguished IEEE Lecturer, University of Texas, Arlington, USA, 2006
- Distinguished Lecturer, CNRS, Pierre and Marie Curie Institute, Paris, France, 2005
- Elected Visiting Fellow, Pembroke College, University of Cambridge, UK, 2005
- Office of Naval Research (ONR) Young Investigator Award, Arlington, USA, 2002
- National Science Foundation (NSF) Faculty CAREER Award, 2001
- University of California Regents Faculty Award, USA, 2000
- US Civil Research and Development Foundation (CRDF) Award, Arlington, USA, 1999
- Merrill Lynch Innovative Engineering Research Award, WTC, New York, USA, 1998
- Outstanding Teaching Assistant Award, University of Notre Dame, USA, 1996
- *Summa Cum Laude*, Moscow Institute of Physics and Technology (MIPT), Russia, 1991

Service Activities

Editor for IEEE Transactions on Nanotechnology

Selected Publications - Past 5 Years

A.A. Balandin, Thermal properties of graphene and nanostructured carbon materials, Nature Materials, 10, 569 (2011)

X. Yang, G. Liu, M. Rostami, A.A. Balandin and K. Mohanram, Graphene ambipolar multiplier phase detector, IEEE Electron Device Letters, 32, 1328 (2011)

S. Ghosh, W. Bao, D.L. Nika, S. Subrina, E.P. Pokatilov, C.N. Lau and A.A. Balandin, Dimensional crossover of thermal transport in few-layer graphene, Nature Materials, 9, 555 (2010)

D. Teweldebrhan, V. Goyal, M. Rahman and A.A. Balandin, Atomically-thin crystalline films and ribbons of bismuth telluride, Applied Physics Letters, 96, 053107 (2010) - Issue's Cover

D. Teweldebrhan, V. Goyal and A.A. Balandin, Exfoliation and characterization of bismuth telluride atomic quintuples and quasi-two-dimensional crystals, Nano Letters, 10, 1209 (2010)

G. Liu, W. Stillman, S. Rumyantsev, Q. Shao, M. Shur and A.A. Balandin, Low-frequency electronic noise in the double-gate single-layer graphene transistors, Applied Physics Letters, 95, 033103 (2009)

D.L. Nika, E.P. Pokatilov, A.S. Askerov and A.A. Balandin, Phonon thermal conduction in graphene: Role of Umklapp and edge roughness scattering, Physical Review B, 79, 155413 (2009) - Editors' Selection

A.A. Balandin, S. Ghosh, W. Bao, I. Calizo, D. Teweldebrhan, F. Miao and C.N. Lau, Superior thermal conductivity of single-layer graphene, Nano Letters, 8, 902 (2008) - cited more than 800 times in three years

MATTHEW BARTH
Yeager Families Endowed Professor
Professor of Electrical Engineering
Director of College of Engineering-Center for Environmental Research and Technology

Education

Ph.D., Electrical and Computer Engineering; University of California, Santa Barbara	1990
M.S., Electrical and Computer Engineering; University of California, Santa Barbara,	1986
B.S., Electrical Engineering / Computer Science; University of Colorado, Boulder	1984

Academic Experience

1992 - present **University of California-Riverside*:***

Electrical Engineering: Professor 2003-present; Associate Professor 1998-2003; Adjunct Assistant Professor 1992-1998. Cooperative faculty appointments: Computer Science, Chemical/Environmental Engineering

UCR Center for Environmental Research and Technology (CE-CERT): Director 2007-present; Interim Director 2004-2007; Associate Director 1998-2003; Research Faculty 1992-1998. Research focus: intelligent transportation systems for the environment, transportation/emissions simulation modeling, sustainable energy systems, electric-drive vehicles, intelligent sensing/control

1990 - 1991 **Department of Systems Engineering, Faculty of Engineering Science, Osaka University, Japan:** Visiting Research Postdoctoral Fellow. Investigated transportation technology, mobile agent navigation, computer vision, and control

1985 - 1990 **Center for Robotic Systems in Microelectronics, University of California, Santa Barbara**: Graduate Research Assistant. Member of the robot perception group. Emphasis on attentive vision techniques, multi-level feedback sensory/control mechanisms, machine color vision, and embedded systems

1979 - 1984 **Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder**: Command controller of university research satellite, data logging/analysis

Non-Academic Experience

1985 - 1986 **General Research Corporation, Santa Barbara, California**: Member of the Technical Staff, Advanced Technology Division. Developed data acquisition systems and electronics associated with electro-optical electromagnetic photonic field sensors

Current Memberships in Professional Organizations

- Institute of Electrical and Electronic Engineering (IEEE): Senior Member, Intelligent Transportation System Society, Vehicular Technology Society

- Institute of Electrical and Electronic Engineering (IEEE): Intelligent Transportation System Society Vice President (Conferences)
- Transportation Research Board: Member, Transportation and Air Quality Committee; New Transportation Technology Committee, Climate Change Subcommittee
- U.S. EPA Mobile Sources Technical Review Subcommittee: Co-Chair, Modeling Workgroup
- ITS America: Sustainable Transportation Committee
- Southern California Association of Governments: Committee Member, University Advisory Group

Honors and Awards

- Yeager Families Endowed Chair in Engineering at UC Riverside, 2007 – present
- Federal Highway Administration Connected Vehicle Technology Challenge Award, 2011
- Innovative Transportation Systems Clean Air Award, Air Quality Management District, 2010
- Member of the Governor's Expert Panel on Transportation Research & Technology, 2008
- Transportation Research Board Pyke Johnson Award, 2006

Service Activities

- UCR Center for Environmental Research and Technology, Director
- UCR Center for Sustainable Suburban Development, Advisory Board Member
- UCR Conflict of Interest Committee, Committee Member
- UCR Committee on Resource Planning, Committee Member
- UCR Vice Chancellor of Research Search Committee
- UC-wide, University of California Transportation Center, Associate Director

Selected Example Publications

Vu, A. Ramanandan, A. Chen, J. Farrell, M. Barth, "Real-Time Computer Vision/DGPS-Aided Inertial Navigation System for Lane-Level Vehicle Navigation," in press, IEEE Trans. on Intelligent Transportation Systems, 2012.

W. Zhu, K. Boriboonsomsin, M. Barth, "Defining a Freeway Mobility Index for Roadway Navigation," Journal of Intelligent Transportation Systems, 14, 1, 37-50, 2009.

M. Li, K. Boriboonsomsin, G. Wu, W. Zhang, and M. Barth "Traffic Energy and Emission Reductions at Signalized Intersections: A Study of the Benefits of Advanced Driver Information", International Journal of ITS Research, Vol. 7, No. 1, pp. 49-58, 2009.

K. Boriboonsomsin and M. Barth "Impacts of road grade on fuel consumption and carbon dioxide emissions evidenced by use of advanced navigation systems", Transportation Research Record No. 2139, Transportation Research Board, National Academy of Science, pp. 21-30, 2009.

Selected Professional Development Activities

- UC Export Control Annual Training, 2010 – present
- UC Conflict of Interest Annual Training, 2006 – present
- UC Procard Training and Assessment course, 2006 – present

BIR BHANU

Distinguished Professor of Electrical Engineering

Education

Ph.D., Elect. Engineering, University of Southern California, Image Processing Institute	1981
S.M., Elect. Engg. & Comp. Sc., Massachusetts Inst. of Technology, Res. Lab Electronics	1977
E.E., Elect. Engg., Massachusetts Inst. of Technology, Res. Lab Electronics	1977
M.B.A. Business Administration, University of California, Irvine	1984
M.E. (Distinction), Electronics Engineering, Birla Inst. of Technology & Science, Pilani	1974
B.S. (Honors), Electronics Engineering, Institute of Technology, BHU, Varanasi	1972
Diploma in German, BHU, Varanasi	1971

Academic Experience

2010 – Present. Distinguished Professor of Electrical Engineering, Cooperative Professor CSE, Mechanical Engg., Graduate Faculty Bioengineering, UC Riverside (UCR)

1998 – Present. Director Center for Research in Intelligent Systems (CRIS), UCR

1991 – 2010. Professor of Electrical Engineering, Cooperative Professor of Computer Science & Engineering, Director - Visualization and Intelligent Systems Laboratory, UCR

1991 – 1994. Founding Chair, Electrical Engineering, UCR

1987 – 1990. Adjunct Faculty, Computer Science, University of Utah, Salt Lake City

1984 – 1987. Assistant Professor, Associate Professor of Computer Science, University of Utah,

1974 – 1975. Lecturer, Department of Electrical & Electronics Engineering, Birla Institute of Technology & Science, Pilani

Non-Academic Experience

- 1986-1991. Honeywell Inc. Senior Honeywell Fellow. Fellows are the top technical professionals (70 out of 130,000 employees), demonstrate extraordinary technical performance in key technologies and instrumental in developing corporate strategic plans. Technologies covered – Signal and Image Processing Science Area – Machine Vision Technology, Artificial Intelligence, Multisensor Fusion and Signal Processing Architectures (Full Time Position)
- 1981-1984. Ford Aerospace & Communications Corporation. Engineering Specialist in Digital Systems. Responsible for R&D work and providing a leadership role for the Aeronutronic Division in the areas of Computer Vision, Artificial Intelligence and Pattern Recognition as applied to defense problems. (Full Time Position)
- 12/80-3/81. INRIA, France. Research Fellow in 3-D Computer Vision. (Full Time Position)
- 1978. IBM San Jose Research Laboratory, Academic Associate. (Summer Full Time Position)

Current Memberships in Professional Organizations

- Fellow SPIE 2003, Fellow IAPR 2000, Fellow AAAS 1997, Fellow IEEE 1995
- Member ACM, Member AAAI

Selected Recent Honors and Awards

- Doctoral Dissertation/Mentor Award of the Graduate Council, UCR, June 2011.
- Best Entry Award (with student Songfan Yang), International Competition on Facial Expression Recognition, held in conjunction with 9th IEEE International Conference on Automated Face and Gesture Recognition, Santa Barbara, March 21-25, 2011.
- Bourns College of Engineering Research Excellence Award, UCR, November 2003.
- Two Awards for Outstanding Papers Published in Pattern Recognition Journal 2000, 1990.
- Award and plaque from the President and Chief Operating Officer of Honeywell Inc. on inertial-navigation sensor integrated image-based navigation, 1992.
- Alpha Team Award on DARPA Scene Dynamics Program, 1989.
- IBM Project Award for Outstanding Contribution, 1978.
- Award for Securing First Position, Institute of Technology, BHU, Received Award from the Education Minister (Prof. Nurul Hasan), Govt. of India, 1971.

Selected Service Activities

- IEEE Fellow Committee (2010, 2011, 2012)
- Chair, IEEE Computer Society Workshop on Biometrics, June 2012.
- UCR Senate, Planning and Budget Committee (2011- Present)
- UCR Senate Education Policy Committee (2006-2010)

Selected Publications (Five from over 400)

Y. Sun and B. Bhanu, "Reflection symmetry integrated image segmentation," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 2012.
S. Yang and B. Bhanu, "Understanding discrete facial expressions using emotion avatar image," *IEEE Transactions on Systems, Man and Cybernetics-Part B*, 2012.
M. Kafai and B. Bhanu, "Dynamic Bayesian networks for vehicle classification in video," *IEEE Transactions on Industrial Informatics*, Vol. 8, No. 1, pp. 100-109, Feb. 2012.
Y. Li and B. Bhanu, "Utility-based camera assignment in a video network: A game theoretic framework," *IEEE Sensors Journal*, Special Issue on Cognitive Networks, Vol. 11(3), pp. 676-687, 2011.
N. Ghosh, R. Recker, A. Shah, B. Bhanu, S. Ashwal and A. Obenaus, "Automated ischemic lesion detection in a neonatal model of hypoxic ischemic injury," *Journal of Magnetic Resonance Imaging,* 33:772–781, 2011.

Selected Professional Development Activities

- Sexual Harassment Prevention Training, UCR, 2012.
- Leadership Development, Center for Creative Leadership, Eckerd College, FL
- Participative Problem Solving, Honeywell Inc., Minneapolis, MN
- Human Interaction Laboratory, NTL Institute, Bethel, ME
- Presentation for Senior Executives, Minneapolis, MN
- Dynamics of Leadership, Minneapolis, MN

GANG CHEN

Associate Adjunct Professor, Department of Electrical Engineering

Education

Ph.D., Optical Engineering, Shanghai Institute of Optics and Fine Mechanics (SIOM), Chinese Academy of Sciences (CAS), China, March 2004.
M.S., Optical Engineering, Chengdu Institute of Optics and Electronics, CAS, China, July 1997.
B.S., Measuring and Control Engineering, Sichuan University, China, July 1994.

Academic Experience

In chronological order: institutions and appointments. Include any chairmanships or coordinator roles:

Associate Adjunct Professor, Department of Electrical Engineering, University of California, Riverside 8/2011- present,
Associate Research Engineer, Department of Electrical Engineering, University of California, Riverside 3/2011- 7/2011,
12/2006-2/2011, Postdoctoral Researcher, Department of Electrical Engineering, University of California, Riverside
1/2001-12/2006, Associate Professor, Shanghai Institute of Optics and Fine Mechanics.
7/1997-12/2000, Assistant Professor, Shanghai Institute of Optics and Fine Mechanics.

Certifications or Professional Registrations

None

Current Memberships in Professional Organizations

Member of SPIE
Member of IEEE

Honors and Awards

Excellent Performance Award, Shanghai Institute of Optics and Fine Mechanics, 2002.
Best paper nomination, academic interchange symposium of electro-optical technology of China, 2000
Outstanding Student Award, Sichuan University, China, 1992 to 1994

Service Activities

- Co-Organizer, IEEE Globecom 2010, Workshop on Optical Wireless Communications (OWC 2010), Miami, Florida, December 6-10, 2010.
- Co-Organizer, ARO/ARL Workshop on Ultraviolet Devices and Communication Systems, College Park, Maryland, April 23, 2008.
- Paper reviewer for journals and conferences: Journal of Lightwave Technology, Optics Communications, Applied Optics, Chinese Optics Letters, Infrared and Laser

Engineering, Acta Optica Sinica, IEEE GLOBECOM, and SPIE Free-Space Laser Communications.

- Co-Organizer, 8th IEEE Optoelectronics and Communications Conference (OECC), Shanghai, China, 8-11, July 2003.
- Senior member of China Institute of Communications, 2002 – 2006

Selected Publications, Past 5 Years

H. Ding, G. Chen, Z. Xu, and B. M. Sadler, "Characterization and modeling of non-line-of-sight ultraviolet scattering communication channels," IET Communications Special Issue on Photonic and Free Space Optics Networks, accepted, Nov. 2011.

K. Cui, G. Chen, Z. Xu, and R. Roberts, "Traffic Light to Vehicle VLC Channel Characterization," submitted (Dec.2011) to IEEE Transactions on Vehicular , under review.

G. Chen, Z. Xu, and B. M. Sadler, "Experimental demonstration of ultraviolet pulse broadening in short-range non-line-of-sight communication channels," Optics Express, vol. 18, no. 10, pp. 10500-10509, May 2010.

G. Chen, Z. Xu, H. Ding, and B. M. Sadler, "Path loss modeling and performance trade-off study for short-range non-line-of-sight ultraviolet communications," Optics Express, vol. 17, no. 5, pp. 3929-3940, March 2009.

H. Ding, G. Chen, A. Majumdar, B. M. Sadler, and Z. Xu, "Modeling of non-line-of-sight ultraviolet scattering channels for communication," IEEE Journal on Selected Areas in Communications, Special Issue on Optical Wireless Communications, vol. 27, no. 9, pp. 1535-1544, December 2009.

G. Chen, F. Abou-Galala, Z. Xu, and B. M. Sadler, "Experimental evaluation of LED-based solar blind NLOS communication links," Optics Express, vol. 16, no. 19, pp. 15059-15068, September 2008.

Z. Xu, H. Ding, B. M. Sadler, and G. Chen, "Analytical performance study of solar blind non-line-of-sight ultraviolet short-range communication links," Optics Letters, vol. 33, no. 16, pp. 1860-1862, August 2008.

Selected Professional Development Activities

None

ROMAN CHOMKO, Ph.D.
Lecturer, Department of Electrical Engineering

Education

Ph.D., Physics, University of Miami	1999
M.S., Applied Physics, Moscow Institute of Physics and Technology, Moscow, Russia	1994
B.S., Natural Sciences, Moscow Institute of Physics and Technology, Moscow, Russia	1994

Academic Experience

1992-1994. Research Assistant, Institute of Radio-Engineering and Electronics, Moscow, Russia
1996-1999. Research Assistant, Department of Physics, University of Miami
1999-2002. Post-Doctoral Research Associate, Department of Physics, University of Miami
2002-2003. Assistant Scientist, Department of Physics, University of Miami
2003-2006. Assistant Research Professor, ECE, Florida International University
2006-2008. Research Faculty, Electrical Engineering, University of California, Riverside
2008-present. Lecturer of Electrical Engineering, University of California, Riverside

Non-Academic Experience

- 1989-1990, Researcher, Biomed Equipment Corp, Boryslav, Ukraine
- Summer 1991, 1992, Systems Software Engineer, PhysTech Corp, Dolgoprudny, Russia
- 03-06/1992, Software Engineer, Digital Equipment Corp (DEC), Moscow Branch, Russia
- 2009-present, President and CEO, Jastrub Inc (owner)

Certifications or Professional Registrations

Diploma of Engineer-Physicist, Moscow Institute of Physics and Technology, Moscow, Russia, 1994

Current Memberships in Professional Organizations

- Member of National Science Foundation Review Panels
- Reviewer of journal Applied Optics
- Reviewer of journal IEEE Transactions of Magnetics
- Reviewer of journal IEEE Transactions of Nanotechnology
- Reviewer for Nanotechnology
- Editor for IEEE Proceedings for Nanoscale Devices and System Integration

Honors and Awards

- UC Discovery, grant #189573, "Heat-Assisted Magnetic Recording", PI, $99,605, 07/01/11-06/30/12
- National Science Foundation, grant #: ECS-0401297, “Three-Dimensional Magnetic Memory Device”,Co-PI, $300,000, 06/01/04-05/31/08

- US Air Force Office of Scientific Research (AFOSR), grant #: FA9550-05-1-0232, “Dense Memory,” Co-
- PI, $1,037,934, 04/01/05-03/31/08
- Research under National Aeronautics and Space Administration (NASA), Goddard Space Flight Center
- Contracts NAS5-31363 and NAS5-31734
- College of Art and Sciences of the University of Miami Outstanding Graduate Research Award (1999)
- University of Miami Research Assistantship (1997/98, 1998/99)
- College of Art and Scences Outstanding Teaching Assistant (1996/97), University of Miami
- Moscow Institute of Physics and Technology Outstanding Student Fellowship (1992/93,1993/94)

Selected Publications, Past 5 Years

BOOK CHAPTERS

S. Khizroev, R. Chomko, and D. Litvinov, chapter “Nanoscale Magnetic Devices” in Handbook of Semiconductor Nanostructures and Nanodevices, edited by A.A. Balandin and K.L. Wang, American Scientific Publishers, 2005; ISBN 1-58883-073-X

S. Khizroev, R. Chomko, and D. Litvinov, chapter in the engineering handbook “Nano-scale and Bio-inspired Integrated Computing, Wiley Publishing, 2008

JOURNAL PUBLICATIONS (2007 – present)

(invited) S. Khizroev, R. Ikkawi, N. Amos, V. Renugopalakrishnan, R. Chomko, R. Haddon, D. Litvinov, “Protein-based memory,” Materials Research Society (MRS) Bulletin, September issue, 2008.

R. Ikkawi, N. Amos, A. Krichevsky, R. Chomko, D. Litvinov, S. Khizroev, “Nanolasers to enable data storage beyond 10 terabit/in2, “Appl. Phys. Lett. 91 (15), 3115-6 (2007)

(invited) S. Khizroev, Y. Hijazi, N. Amos, E. Felissaint, N. Joshi, R. Ikkawi, R. Chomko, and D. Litvinov, “Physics of Perpendicular Recording with a Patterned Soft Underlayer,” special information technologies issue, J. Nanoscience and Nanotechnology 7, 243-54 (2007)

N. Amos, A. Lavrenov, P. Gomez, F. Candocia, D. Litvinov, R. Chomko, S. Khizroev, “Nanomagnetic probes to image patterned media for information densities above ten terabit-per square-inch,” submitted to J. Nanoelectronics and Optoelectronics, (2007)

Selected Professional Development Activities

Multiple industrial activities including but not limited to participation in Industrial Expo’s, Trade-Shows, Conferences, etc.

ILYA DUMER
Professor, Department of Electrical Engineering

Education

Ph.D. (Information Theory), Russian Academy of Sciences, Moscow	1981
M.S. (Electrical Engineering), Moscow Institute of Physics and Technology	1976
B.S. (Electrical Engineering), Moscow Institute of Physics and Technology	1974

Appointments

1995 – present	Professor, Electrical Engineering, University of California at Riverside
1987 – 1995	Senior Researcher, Institute for Information Transmission Problems (IIPT), Russian Academy of Sciences, Moscow, Russia
1983 – 1987	Researcher, Institute for Information Transmission Problems, Russian Academy of Sciences, Moscow, Russia

Honors and Awards

IEEE Fellow, 2007
Alexander von Humboldt Research Fellow, Institute for Experimental Mathematics, Essen, Germany, 1993-1994
Royal Society Guest Research Fellow, Manchester University, UK, 1992-1993

Professional Activities

- Associate Editor for Coding Theory: IEEE Transactions on Information Theory, 2006-2009
- Member of the Program Committees: IEEE International Symposia (1997, 2003, 2005, 2006, 2007, 2008, 2010, 2011), IEEE International Workshop (2010), Workshops on Codes and Cryptography (2005, 2007); Program Co-Chair, International Conference on Coding Theory (2008)
- Referee : IEEE Transactions on Information Theory, Problems of Information Transmission; Codes, Designs, and Cryptography; Finite Fields and Their Applications
- Panel Member: NSF Directorate " Theoretical Foundations - Communications Research" (2000, 2002, 2004, 2005, 2007)
- Chair of Graduate Council at UCR, 2007-2008

Selected Publications

A. A. Kovalev, I. Dumer, and L. P. Pryadko, "Design of additive quantum codes via the code-word-stabilized framework", Phys. Rev. A 84, 062319, pp. 1-11, 2011.
Y. Li, I. Dumer, and L. Pryadko, "Clustered error correction of codeword-stabilized quantum codes," Physical Review Letters, vol. 104, 190501, pp. 1-4, 2010.
Y. Li, I. Dumer, M. Grassl, and L. Pryadko, "Structured error recovery for codeword-stabilized quantum codes," Physical Review A, vol. 81, 052337, pp. 1-12, 2010.

M.Burnashev and I. Dumer, "Error exponents for two soft decision decoding algorithms of Reed—Muller codes," IEEE Trans. Info. Theory, 55, no. 9, pp. 4108-4118, 2009.

I. Dumer, "Equal-weight fingerprinting codes," Lecture Notes Computer Science, vol. 5557, pp. 43-51, 2009.

I. Dumer, G. Kabatiansky, C. Tavernier, "List decoding of biorthogonal codes and the Hadamard transform with linear complexity, " IEEE Trans. Info. Theory, 54, no. 10, pp. 4488-4492, 2008.

N. P. Anthapadmanabhan, A. Barg, and I. Dumer, “Fingerprinting Capacity Under the Marking Assumption,” IEEE Trans. Info. Theory, 54, no. 6, pp. 2678-2689, 2008.

Hossny El-Sherief
Adjunct Professor, Department of Electrical Engineering

Education

Ph.D., Electrical Engineering, McMaster University	1979
M.S., Electrical Engineering, McMaster University	1977
B.S., Mathematics, Aim-Shams University	1975
B.S., Electrical Engineering, Cairo University	1973

Academic Experience

1979-1981. Assistant Professor, Department of Electrical Engineering UPM.
1996-2012. Adjunct Professor, Department of Electrical Engineering UCR.

Non-Academic Experience

1981-1986. Exxon Production Research, Group Leader, Led the activities of the modeling development group. Activities included research and development of advanced algorithms for digital signal processing, modeling and simulation of seismic data

Certifications or Professional Registrations

Received Six Sigma Green Belt Certification, 2002.

Current Memberships in Professional Organizations

None

Honors and Awards

Received the TRW 1995 Chairman's Award for innovation nomination.
Received the TRW 1994 IR&D Honor Roll Achievement Award.

Service Activities

Member of Advisory Boards, Electrical Engineer Department, University of California, Riverside and California State University, Long Beach

Selected Publications, Past 5 Years

"Probabilistic bounds for model validation assessment", W. Liu and J. Chen, Automatica, vol 43, no. 6, pp1064-1071, 2007.
"MEMS: the next generation IMU for Missile Defense Applications," Proceedings of the AIAA Missile Science Conference, Monterey, California, 2006

Selected Professional Development Activities

Export Control Training 2012

JAY ALLEN FARRELL
Professor and Chair, Department of Electrical Engineering

Education

Doctor of Philosophy, Electrical Engineering, University of Notre Dame	1989
Master of Science, Electrical Engineering University of Notre Dame	1987
Bachelor of Science, Electrical Engineering, Iowa State University	1986
Bachelor of Science, Physics, Iowa State University	1986

Academic Experience

Assistant Professor, Electrical Engineering, Univ. of CA-Riverside	Jan. 1994 – June 1997
Associate Professor, Electrical Engineering, Univ. of CA-Riverside	July 1997 – June 2001
Chair of Electrical Engineering Department, Univ. of CA-Riverside	July 1998 – June 2001
Professor, Electrical Engineering, Univ. of CA-Riverside	July 2001 – Present
Chair of Electrical Engineering Department, Univ. of CA-Riverside	July 2011 – Present

Non-Academic Experience

Charles Stark Draper Laboratory, Senior Member of Technical Staff	June 1989 - January 1994

Current Memberships in Professional Organizations

American Association for the Advancement of Science (AAAS), Institute of Electrical Engineering (IEEE), Institute of Navigation (ION)

Honors and Awards

- Charles Stark Draper Laboratory Recognition Award. For outstanding performance and achievement, 1991
- Charles Stark Draper Laboratory Recognition Award. For outstanding performance and achievement, 1993
- Engineering Vice Presidents Annual Award for Best Technical Publication: 1990, "Connectionist Learning Systems for Control," SPIE OE/Boston '90
- Member of the Plenary Panel at the 2007 International Symposium on Neural Networks, June 5, 2007, in Nanjing China. Plenary panelists: S. N. Balakrishnan, Tamer Basar, Tianyou Chai, Jay A. Farrell, DeyiLi, Thomas Parisini, Marios M. Polycarpou, Zengqi Sun, Jun Wang, Paul Werbos, Zongben Xu, June 2007
- IEEE Fellow, January 2008
- Plenary presentation "Vehicle Autonomy and Intelligent Control: Where are we and What Lies Ahead?" IEEE Control Systems Society (CSS), Multiconference on Systems and Control, San Antonio, TX, Sept. 2008.
- Named a GNSS Leader to Watch for 2009-2010 by GPS World Magazine, May 2009
- Member of moderated panel on the "50th Anniversary of the Kalman Filter" at the 2010 Institute of Navigation (ION) Global Navigation Satellite System (GNSS) conference
- 2009 recipient of the CSS Distinguished Member Award, December 2009
- AAAS Fellow, February 2011
- A Winner of Connected Vehicle Technology Challenge -- sponsored by U.S. Dept. of Transp.'s (DOT's) Research and Innovative Technology Administration (RITA), July 2011

Professional Service Activities

- Financial Chair, 2001 IEEE Conf. on Decision and Control, Orlando, FL
- Financial Chair, 2003 IEEE Conference on Decision and Control

- Elected member, IEEE Control Systems Society Board of Governors, Jan. 2003-Jan. 2006.
- IEEE Control System Society Vice President of Financial Affairs, Jan. 2005-Dec. 2006.
- IEEE Control Systems Society Vice-President: Technical Activities, Jan. 2007-Dec. 2008.
- General Vice-Chair, 2011 Joint Euro. Control Conf., IEEE Conf. on Decision and Control
- General Chair of the 51st IEEE Conf. on Decision and Control, December 2012
- Elected member, IEEE Control Systems Society Board of Governors, Jan. 2012-Jan. 2014.

Campus Service Activities

- Sep. 2003-Jun. 2006: Committee on Academic Personnel (CAP)
- Jul. 2007-Jun. 2009: Planning and Budget (P&B)
- Feb. 2009-Jun. 2009: UCR EVC/P Budget Advisory Committee
- Mar. 2009-Jun. 2009: UCR EVC/P BAC Steering Committee
- Jun. 2009-Jun. 2010: Academic Personnel Task Force
- Sep. 2009-Jun. 2010: Chair of the UCR Strategic Planning Resources, Budget Planning and Infrastructure Subcommittee
- Sep. 2009-Jun. 2010: Member, UCR Strategic Planning Steering Committee
- Sep. 2009-Aug. 2012: Chair of the Faculty of the Bourns College of Engineering.
- Sep. 2009-Aug. 2012: Member, UCR Academic Senate Executive Committee
- Jan. 2011-Dec. 2011: Member of UCR's Chancellor's Budget Advisory Council

Selected Publications, Past 5 Years

J. A. Farrell, S. Pang, W. Li, "Chemical Plume Tracing via an Autonomous Underwater Vehicle," IEEE J. of Oceanic Engineering, 30, 2, 428-442, 2005.

W. Li, J. A. Farrell, S. Pang, R. M. Arrieta, "Moth-Inspired Chemical Plume Tracing on an Autonomous Underwater Vehicle," IEEE Transactions on Robotics, 22, 2, pp. 292-307, 2006.

S. Pang, J. A. Farrell, "Chemical Plume Source Localization," IEEE Systems, Man, and Cybernetics - Part B: Cybernetics, 36, 5, 1068-1080, 2006.

W. Dong, J. A. Farrell, "Cooperative Control of Multiple Nonholonomic Mobile Agents," IEEE Transactions on Automatic Control, 53, 6, 1434-1448, 2008.

Y. Zhao, J. A. Farrell, "Localized Adaptive Bounds for Approximation Based Backstepping," Automatica, 44, 10 2008, 2607-2613, 2008.

J. A. Farrell, M. Polycarpou, M. Sharma, W. Dong, "Command Filtered Backstepping," IEEE Transactions on Automatic Control, 54, 6, 1391-1395, 2009.

W. Dong, J. A. Farrell, "Decentralized Cooperative Control of Multiple Nonholonomic Dynamic Systems with Uncertainty," Automatica, 45, 3, 706-710, 2009.

P. Miller, J. A. Farrell, Y. Zhao, V. Djapic, "Autonomous Underwater Vehicle Navigation," May, IEEE Journal of Ocean Engineering, 35, 3 663-678, 2010.

B. Song, A. Kamal, C. Soto, C. Ding, A. Roy-Chowdhury, J. A. Farrell, "Tracking and Activity Recognition through Consensus in Distributed Camera Networks," IEEE Transactions on Information Processing, 19, 10, September 2010, 2564 - 2579, 2010.

Selected Professional Development Activities

UC Export Control Training, 2011.

ELAINE D. HABERER
Assistant Professor, Department of Electrical Engineering

Education

Ph.D., Materials, UC-Santa Barbara	2005
M.S., Materials Science & Engineering, MIT	1998
B.S., Materials Science & Engineering, MIT	1997

Academic Experience

2005-2008. Postdoctoral Fellow, California NanoSystems Institute, UC-Santa Barbara
2005-2006. Visiting Researcher, Department of Materials Science and Engineering, MIT
2008-2010. Assistant Professor III, Department of Electrical Engineering, UCR
2010-Present. Assistant Professor IV, Department of Electrical Engineering, UCR

Non-Academic Experience

Intel Corporation, Co-op Student, Full-Time
Worked with sustaining engineering group to reduce particle generation in a production plasma-enhanced chemical vapor deposition (PECVD) system

Hewlett-Packard, Intern, Full-Time
Designed and tested feasibility of iterative wet etching technique for use in MESFET gate definition in a production environment.

Certifications or Professional Registrations

None.

Current Memberships in Professional Organizations

IEEE, Materials Research Society, AIChE Society for Biological Engineering, and Society of Women Engineers

Honors and Awards

University of California President's Postdoctoral Fellowship 2005-2006, finalist

Service Activities

- Symposium Organizer for Materials Research Society Spring Meeting 2012 (Symposium T: Bio-inspired Materials for Energy Applications)
- Reviewer: Advanced Functional Materials, IEEE Transactions on Nanotechnology, Solid State Electronics, Bioinspiration & Biomimetics
- Developed and co-taught a service-learning course (HNPG 098I – Inspiring Young Scientists with Solar Energy) with Prof. Marsha Ing (UCR Graduate School of Education) through the
- UCR Honors program and the UnderGraduate Research in the Community program. The course centered on the implementation of 3 solar cell lessons in an eighth grade classroom at Mira Loma Middle School.
- EE Undergraduate/ABET Committee, 09/10 – 06/11
- MSE Colloquium Coordinator, 07/10 – present
- MSE Recruiting and Publicity Co-Coordinator, 07/10 – present

- UCR Academic Senate Scholarship and Honors Committee, 09/09 – present
- Society of Women Engineers, UCR Chapter Faculty Co-Advisor, 06/09 – present
- Lead Judge for the Riverside Unified School District Science Fair in the area of Electricity & Electromagnetics, 02/09, 02/10

Selected Publications, Past 5 Years

Enhanced Photogenerated Carrier Collection in Hybrid Films of Bio-Templated Gold Nanowires and Nanocrystalline CdSe, **E. D. Haberer**, J. H. Joo, J. F. Hodelin, E. L. Hu, Nanotechology 20, 415206 (2009).

Room-temperature continuous-wave lasing in GaN/InGaN microdisks, A. C. Tamboli, **E. D. Haberer**, R. Sharma, K. H. Lee, S. Nakamura, E. L. Hu, Nature Photonics 1, 61 (2007)

Electrical Characterization of Bio-templated Nanostructured Photovoltaic Material, J. H. Joo, **E. D. Haberer**, J. C. Hsieh, C-Y. Chiang, A. M. Belcher, and E. L. Hu, Materials Research Society Fall Meeting, Boston, Massachusetts, November 25-29 2007.

Photoelectrochemical etching of m-plane GaN for smooth, low damage etching of optical devices, A. C. Tamboli, M. C. Schmidt, **E. D. Haberer**, K. C. Kim, J. S. Speck, S. P. DenBaars, S. Nakamura, E. L. Hu, 7th International Conference of Nitride Semiconductors, Las Vegas, Nevada, September 16- 21 2007.

Optical properties of GaN microdisks fabricated by photoeleectrochemical etching, A. C. Tamboli, **E. D. Haberer**, R. Sharma, K. H. Lee, S. Nakamura, E. L. Hu, Fourth International School and Conference on Spintronics and Quantum Information Technology, Maui, Hawaii, June 17-22 2007.

Selected Professional Development Activities

UC Export Control Training, 2011
NSF Career Development for New Engineering Faculty Workshop, 2011
CAREER Proposal Workshop, 2011
Grant Writer's Workshop, 2012

YINGBO HUA

Professor, Department of Electrical Engineering

Education

Ph.D., Electrical Engineering, Syracuse University, Syracuse, NY 1988
M.S., Electrical Engineering, Syracuse University, Syracuse, NY 1983
B.S., Control Engineering, Southeast University (former Nanjing Institute of Technology), Nanjing, China, 1982

Academic Experience

1990-1992: Lecturer, University of Melbourne, Victoria, Australia
1993-1995: Senior Lecturer, University of Melbourne, Victoria, Australia
1996-2001: Reader and Associate Professor, University of Melbourne, Victoria, Australia
2001-Present: Professor, University of California, Riverside

Current Memberships in Professional Organizations

IEEE and AAAS

Honors and Awards

- Fellow of AAAS, elected in 2011, for "distinguished contributions to research, teaching and service in signal processing and its applications".
- Fellow of IEEE, elected in 2001, for "contributions to high resolution signal processing and blind system identification".

Service Activities

- Chair, EE Faculty Search Committee, 2001-2004.
- Chair, University of California Industry-University Cooperative Research Program (IUCRP) Executive Committee for Communications and Networking, 2006-2007.
- Member-at-Large, Executive Committee of College of Engineering, 2005-2007.
- Member, University of California Industry-University Cooperative Research Program (IUCRP) Executive Committee for Communications and Networking, 2005-2008.
- Member, Inaugural Steering Committee for IEEE Wireless Communications Letters, 2011-present.
- Guest Editor, IEEE Journal on Selected Areas in Communications (J-SAC), Special Issues on Theories and Methods for Advanced Wireless Relays, 2011-2012.
- Guest Editor, IEEE Signal Processing Magazine Special Issue of Signal Processing for Cognitive Radio Networks, 2007-2008.
- Guest Editor, IEEE Signal Processing Magazine Special Issue of Signal Processing for Wireless Ad Hoc Communication Networks, 2005-2006.
- Editor, IEEE Signal Processing Magazine, 2007-2009.
- Editor, Signal Processing (EURASIP), 2005-2010.
- Editor, IEEE Signal Processing Letters, 1998-2001.
- Editor, IEEE Transactions on Signal Processing, 1994-1997, 2001-2002.
- Member, IEEE Signal Processing Society's Technical Committee on Signal Processing for Communications, 2002-2004, 2005-2007.

- Member, IEEE Signal Processing Society's Technical Committee on Sensor Array and Multichannel Signal Processing, 1998-2001, 2002-2004, 2005-2007, 2010-.
- Member, IEEE Signal Processing Society's Technical Committee on Underwater Acoustic Signal Processing, 1997-1998.
- Member of Advisory and/or Technical Program Committees for more than 40 International Conferences and Workshops since 1992.
- Reviewer of papers for over 25 international journals since 1985.
- Reviewer of grant proposals for National Science Foundation, Army Research Office, Air Force Office of Scientific Research, University of California Discovery, Research Council of Hong Kong, Australian Research Council, National Science Foundation Ireland

Selected Publications

TANG, X., HUA, Y., "Optimal design of non-regenerative MIMO wireless relays", IEEE Transactions on Wireless Communications, Vol. 6, No. 4, pp. 1398-1407, April 2007.

HONG, K., and HUA, Y., "Throughput analysis of large wireless networks with regular topologies," EURASIP Journal on Wireless Communications and Networking, Vol. 2007 (2007), Article ID 26760, 11 pages.

CHANG, Y., HUA, Y., XIA, X.-G., SADLER, B. M., "An insight into space-time block codes using Hurwitz-Radon families of matrices," Signal Processing, (2008), Vol. 88, pp. 2030-2062.

ZHAO, B., and HUA, Y., "A distributed medium access control scheme for a large network of wireless routers," IEEE Transactions on Wireless Communications, Vol. 7, No. 5, pp. 1614-1622, May 2008.

RONG, Y., TANG, X., and HUA, Y., "A unified framework for optimizing linear non-regenerative multicarrier MIMO relay communication systems," IEEE Transactions on Signal Processing, Vol. 57, No. 12, pp. 4837-4851, Dec 2009.

YU, Y., and HUA, Y., "Power allocation for a MIMO relay system with multiple-antenna users", IEEE Transactions on Signal Processing, Vol. 58, No. 5, pp. 2823-2835, May 2010.

XU, S., and HUA, Y., "Optimal design of spatial source-and-relay matrices for a non-regenerative two-way MIMO relay system," IEEE Transactions on Wireless Communications, Vol. 10, No. 5, pp. 1645-1655, May 2011.

HUANG, Y., and HUA, Y., "On energy for progressive and consensus estimation in multihop sensor networks," IEEE Transactions on Signal Processing, Vol. 59, No. 8, pp. 3863-3875, Aug 2011.

KONG, T., and HUA, Y., "Optimal Design of Source and Relay Pilots for MIMO Relay Channel Estimation," IEEE Transactions on Signal Processing, Vol. 59, No. 9, pp. 4438-4446, Sept. 2011.

Selected Professional Development Activities

UC Export Control training in 2011.

ALEXANDER KHITUN

Associate Adjunct Professor, Department of Electrical Engineering

Education

Ph.D. Applied Physics and Mathematics, MIPT, Russia 1995
M.S. Applied Physics and Mathematics, MIPT, Russia 1991
B.S. Applied Physics and Mathematics, Moscow Institute of Physics and Technology (MIPT), Russia 1989

Academic Experience

Feb 2011 – present Associate Research Engineer and Associate Adjunct Professor Electrical Engineering Department University of California, Riverside
Feb 2005 – Jan 2011 Assistant Research Engineer, Electrical Engineering Department, University of California, Los Angeles (UCLA)
Jan 1999 – Feb 2005 Postdoctoral Researcher (UCLA)
Nov 1991 - Jan 1999 Research Fellow, Fiber Optics Research Center, General Physics Institute of the Russian Academy of Sciences, Moscow

AWARDS & HONORS

- **Inventor Recognition Award** from Microelectronics Advanced Research Corporation (MARCO, 2008)
- **Guest Editor** for the special issue on Spintronics for the Journal of Nanoelectronics and Optoelectronics (2008)
- **Inventor Recognition Award** from Microelectronics Advanced Research Corporation (MARCO, 2006)
- Research Highlighted by **UCLA News Release "UCLA Engineers Announce Breakthrough in Semiconductor Research: Three Highly Interconnected Nanoscale Architectures Using Spin-Wave Technology"(May 4, 2006)**
- **Program Committee member for** 2nd IEEE International Workshop on Defect and Fault Tolerant Nanoscale Architectures (NANOARCH 2006)
- **Best Paper** Award (SCI, Florida, 2003)
- Nominated to **Chancellor's Award** for Postdoctoral Research (University of California Los Angeles, 2001)
- **Best Young Scientist** Theoretical Work (FORC, Moscow 1996)
- **Journal Reviewer**: Applied Physics Letters, Journal of Applied Physics, IEEE Transactions on Electron Devices

RESEARCH

Alexander Khitun's research is in the areas of nanoelectronics, spintronics and nanoarchitectonics. He is the lead author of spin-wave based devices and magnetic unconventional computational paradigms and their physical realization. Currently, Dr. Khitun is leading the group of scientists from UCR, UCLA, UCI, Yale, and UMASS towards the realization of the first non-volatile magnonic logic circuit (DARPA project on non-volatile magnetic logic). His pioneer works on logic circuits with spin wave bus has attracted a great deal of interest from the industry and have been recognized by the invention recognition award (MARCO 2006, 2008).

PUBLICATIONS

Dr. Khitun has published over 70 technical publications and given over 10 invited and keynote talks at international conferences and workshops. Additionally, he has co-authored three book chapters.

SELECTED PUBLICATIONS

Khitun A., Bao M., and Wang K.L., **Spin Wave Magnetic Nanofabric: A New Approach to Spin-Based Logic Circuitry**, *IEEE Transactions on Magnetics*, Vol. 44, (9), pp.2141-53, 2008.

Khitun A., Nikonov D.E., Bao M., Galatsis K., and Wang K.L., **Feasibility Study of Logic Circuits with Spin Wave Bus**, *Nanotechnology* 18, pp 456202-11, (2007).

Khitun A. and Wang K.L., **On Logic Circuits with Spin Wave Bus,** *Journal of Nanoelectronics and optoelectronics*, Vol 1, (1), pp. 71-3, (2006).

Khitun A. and Wang K.L., **Nano scale computational architectures with Spin Wave Bus,** *Superlattices and Microstructures*, vol.38, pp. 184-200, (2005).

Khitun A., Ostroumov R. and Wang K.L., **Spin-wave utilization in a quantum computer,** *Physical Review A*, vol.64, (no.6), pp.062304/1-5,(2001).

SYNERGISTIC ACTIVITIES

Principle Investigator (PI) for the DARPA project on Non-Volatile Logic
Co-PI for the Western Institute of Nanoelectronics (WIN)

RECENT COLLABORATORS

Dimitri Nikonov (Intel)
Andras Csaba Moritz (University of Massachusetts, Amherst)

SAKHRAT KHIZROEV

Adjunct Professor, Department of Electrical Engineering

Education

Ph.D., Electrical and Computer Engineering, Carnegie Mellon University	1999
M.S., Physics, University of Miami	1994
B.S., Physical and Quantum Electronics, Moscow Institute of Physics and Technology	1992

Academic Experience

2003 – 2006 , Associate Professor (tenured), ECE, Florida International Un. (FIU), Miami, FL
2006-2009, Associate Professor (tenured), EE, UCR; 2009-2010, Professor (tenured), EE, UCR
2011-present, Adjunct Professor, EE, UCR
2011-present, Professor (tenured), ECE, FIU; Director, Center for Nanomedicine, FIU

Non-Academic Experience

1997-1998, IBM Almaden Research Center, Doctoral Intern, San Jose, CA
1999-2003, Seagate Research, Research Staff Member (permanent position), Pittsburgh, PA

Current Memberships in Professional Organizations

- Senior Member of ***IEEE*****,** Member of ***APS, ACES***
- Member of Editorial Board for ***Nanotechnology, Science and Applications, Dove Medical Press***, ***Journal in Nanotechnology***, ***Research Letters in Nanotechnology***, ***Recent Patents on Electrical Engineering***, Bentham Science, ***Journal of Nanoelectronics and Optoelectronics***, ***Journal of Bionanoscience***, *Dataset Papers in Nanotechnology, and others*

Selected Honors and Awards

2005-	Senior Member, IEEE
2004	Top 10 Inventors of the Year, Seagate Technology
1999-2002	29 Technology Achievement Awards, Seagate Technology
1999-2000	Key Employee Award, Seagate Technology
1997-1999	IBM Doctoral Fellowships (two in a row)
1989-1990	Rector 's Fellowship (selective award usually given to one at a department of 100 students for outstanding academic achievements), Moscow Institute of Physics and Technology (MIPT, aka PhysTech)

Service Activities

- Associate Editor for ***IEEE Trans. Nanotechnology (T-Nano), 2003-2006;*** Guest Editor for ***IEEE Transactions on Magnetics***, and IOP journal ***Nanotechnology;*** Reviewer for ***IEEE Trans. Magn***., ***IEEE Trans. Nanotechnology*** and various journals of ***American Institute of Physics (AIP), Institute of Physics (IOP), Elsevier, Materials Research Society,*** etc.
- External Reviewer on a Faculty Promotion-Tenure Committee (Jingsheng Chen, 2012-2013), **National University of Singapore (NUS)**
- Panel Reviewer at **NSF**, **DoE**, **DoD,** and other agencies

Selected Publications, Past 5 Years

J. Hong, S. Niyogi, E. Bekyarova, M. Itkis, P. Ramesh, R. C. Haddon, C. Berger, W. A. DeHeer, and **S. Khizroev**, "Effect of functionalization on the electrostatic charging, tunneling, and Raman spectroscopy of epitaxial graphene," *JVST B – Microelectronics and Nanometer Structures* **30** (3), 1-5 (2012)

S. Niyogi, E. Bekyarova, J. Hong, **S. Khizroev**, C. Berger, W. de Heer, R. Haddon, "Covalent chemistry for graphene electronics," *J. Phys. Chem. Lett*. **2** (19), 2487-2498 (2011) (cover page)

R. Fernandez, N. Amos, C. Zhang, B. Lee, **S. Khizroev**, "Optimization of $L1_0$-FePt/MgO/CrRu thin films for next-generation magnetic recording media," *Thin Solid Films* **519** (22), 80537 (2011)

B. Hu, N. Amos, Y. Tian, J. Butler, D. Litvinov, **S. Khizroev**, "Study of Co/Pd multilayers as a candidate material for next generation magnetic media," *J. Appl. Phys*. **109** (3), 034314 (2011)

R. Fernandez, D. Teweldebrham, C.Zhang, N.Amos, A. Balandin, **S. Khizroev**, "A comparative analysis of Ag and Cu heat sink layers in $L1_0$-FePt films for the high-density heat-assisted magnetic recording," *J. Appl.Phys*. **109**, 07B763 (2011)

J. Hong, E. Bekyarova, M. Itkis, P. Ramesh, N. Amos, D. Litvinov, C. Berger, W. A. De Heer, **S. Khizroev**, R. C. Haddon, , "Effect of nitrophenyl functionalization on the magnetic properties of epitaxial graphene," *SMALL* **7** (9), 1175-80 (2011)

M. Hudgins, **S. Khizroev**, "Considerations for the implementation of 2D protein memory," *J. Nanoscience and Nanotechnology* **11** (3), 2520-3 (2011)

N. Amos, A. Lavrenov, R. Fernandez, R. Ikkawi, D. Litvinov, and **S. Khizroev**, "High-resolution and high-coercivity FePt $L1_0$ magnetic force microscopy nanoprobes to study next-generation magnetic recording media," *J. Appl. Phys*. **105**, 07D526 (2009)

N. Amos, R. Ikkawi, R. Haddon, D. Litvinov, and **S. Khizroev**, "Controlling multi-domain states to enable sub-10-nm magnetic force microscopy," *Appl. Phys. Lett*. **93**, 203116 (2008);

D. Litvinov, V. Parekh, C. E, D. Smith, J. Rantschler, P. Ruchhoeft, D. Weller, and **S. Khizroev**, "Recording physics, design considerations, and fabrication of nanoscale bit-patterned media," *IEEE Trans. Nanotechnology* **7** (4), 463-76 (2008)

(invited) **S. Khizroev**, R. Ikkawi, N. Amos, R. Chomko, R. Haddon, D. Litvinov, "Protein-based memory," *Materials Research Society (MRS) Bulletin* **33** (9), 864-71 (2008)

R. Ikkawi, A. Krichevsky, A. Lavrenov, N. Amos, D. Litvinov, **S. Khizroev**, "Exploiting far- and near-field optics to develop energy efficient transducer for HAMR," *IEEE Trans. Magn.* **44** (11), 3364-7 (2008)

P. Gomez, D. Litvinov, **S. Khizroev**, "Minimum parameters required to enable low-field low-size nano nuclear magnetic resonance (NanoNMR)," *IEEE Trans. Magn*. **44** (11), 4464-7 (2008)

N. Amos, R. Fernandez, R. Ikkawi, B. Lee, A. Lavrenov, A. Krichevsky, D. Litvinov, **S. Khizroev**, "Magnetic force microscopy study of magnetic stripe domains in sputter deposited Permalloy thin films, " *J. Appl. Phys*. **103** (7), 07E732 (2008)

R. Ikkawi, N. Amos, A. Krichevsky, R. Chomko, D. Litvinov, **S. Khizroev**, "Nanolasers to enable data storage beyond 10 terabit/in^2, "*Appl. Phys. Lett.* **91** (15), 3115-6 (2007)

ALEXANDER KOROTKOV
Professor, Department of Electrical Engineering

Education

Ph.D. in Physics, Moscow State University (Russia)	1991
M.S. in Physics, Moscow State University	1996

Academic Experience

1992-1993 Scientist, Dept. of Microelectronics, Institute of Nuclear Physics, Moscow State University
1993-1996 Postdoctoral Research Associate, Department of Physics and Astronomy, State University of New York at Stony Brook
1996-1998 Senior Scientist, Dept. of Microelectronics, Institute of Nuclear Physics, Moscow State University
1998-1999 Research Scientist, Department of Physics and Astronomy, State University of New York at Stony Brook
1999-2000 Research Assistant Professor, Department of Physics and Astronomy, State University of New York at Stony Brook
2000-2002 Assistant Professor, Step IV, Department of Electrical Engineering, UCR
2002-2004 Associate Professor, Step II, Department of Electrical Engineering, UCR
2004-2006 Associate Professor, Step III, Department of Electrical Engineering, UCR
2006-2009 Professor, Step I, Department of Electrical Engineering, UCR
2009-present Professor, Step II, Department of Electrical Engineering, UCR

Non-Academic Experience

Visiting position (Feb. 1997 – May 1997), NEC Fundamental Research Laboratories, Tsukuba, Japan, Researcher.

Certifications or Professional Registrations

None

Current Memberships in Professional Organizations

APS, IEEE

Honors and Awards

Major Research Grants:

ARO, $443K (2001-2004);
ARO, $538K (2004-2009)
ARO, $97K (208-2009)

ARO, $123K (2008-2010)
ARO, $462K (2010-2012);
ARO, $97K (2011-2012)

Service Activities

Reviewer for many journals, reviewer of grant proposals for NSF, DOE, etc., Editorial board member for a journal

Selected Publications, Past 5 Years

N. Katz, M. Neeley, M. Ansmann, R. C. Bialczak, M. Hofheinz, E. Lucero, A. O'Connell, H. Wang, A. N. Cleland, J. M. Martinis, and A. N. Korotkov, "Reversal of the weak measurement of a quantum state in a superconducting phase qubit", Phys. Rev. Lett. **101**, 200401 (2008).

A. G. Kofman and A. N. Korotkov, "Analysis of Bell inequality violation in superconducting phase qubits," Phys. Rev. B **77**, 104502 (2008).

A. N. Korotkov, "Special issue on quantum computing with superconducting qubits", Quantum Inf. Process. **8**, 51 (2009). (Editorial paper.)

A. G. Kofman and A. N. Korotkov, "Two-qubit decoherence mechanisms revealed via quantum process tomography", Phys. Rev. A **80**, 042103 (2009).

A. Palacios-Laloy, F. Mallet, F. Nguyen, P. Bertet, D. Vion, D. Esteve, and A. Korotkov, "Experimental violation of a Bell's inequality in time with weak measurement", Nature Physics **6**, 442 (2010).

A. N. Korotkov and K. Keane, "Decoherence suppression by quantum measurement reversal", Phys. Rev. A **81**, 040103(R) (2010).

A. N. Korotkov, "Flying microwave qubits with nearly perfect transfer efficiency", Phys. Rev. B **84**, 014510 (2011).

M. Mariantoni, H. Wang, T. Yamamoto, M. Neeley, R.C. Bialczak, Y. Chen, M. Lenander, E. Lucero, A.D. O’Connell, D. Sank, M. Weides, J. Wenner, Y. Yin, J. Zhao, A.N. Korotkov, A.N. Cleland, and J.M. Martinis, "Implementing the quantum von Neumann architecture with superconducting circuits", Science **334**, 61 (2011).

A.N. Korotkov, "Entanglement preservation: the Sleeping Beauty approach", Nature Physics, **8**, 107 (2012).

Selected Professional Development Activities
None

ROGER LAKE

Professor, Department of Electrical Engineering

Education

Ph.D., Electrical Engineering, Purdue University	1992
M.S.E.E, Electrical Engineering, Purdue University	1988
B.S.E.E., Electrical Engineering, Purdue University	1986

Academic Experience

2000-2006. Associate Professor, Department of Electrical Engineering UCR.
2001-2006 Graduate Advisor, Department of Electrical Engineering UCR.
2006-. Professor, Department of Electrical Engineering, UCR.
2006-2011 Chair, Department of Electrical Engineering UCR.
2007 – Faculty Member, Material Science and Engineering, UCR.
2008 – Cooperating Faculty Member, Computer Science and Engineering, UCR.

Non-Academic Experience

1993–1997, Texas Instruments, Central Research Labs, Member Technical Staff, Research position. Full-time. Dallas, TX.
1997-2000, Raytheon Systems, Applied Research Lab, Sr. Physics Engineer, Research Position. Full-time. Dallas, TX.

Certifications or Professional Registrations

Current Memberships in Professional Organizations

Member, MRS, APS, AAAS
Senior Member, IEEE

Honors and Awards

Semiconductor Research Corporation Fellowship, 1988-1992.

Service Activities

- Associate Editor, IEEE Transactions on Nanotechnology, 2/2006 – 2/2012
- Editor, IEEE Transactions on Electron Devices, 2/2012 -
- California Nanotechnology Collaborative (CNC) Advisory Board Member
- Session Chair, Spring Meeting of the MRS, San Francisco, CA, April 29, 2011

Selected Publications, Past 5 Years

M. Ashraf, R. Pandey, R. Lake, B. Millare, A. Gerasimenko, D. Bao, V. Vullev, "Theoretical design of bioinspired macromolecular electrets based on anthranilamide derivatives," Biotechnology Progress, 25, 4, 915 - 922, (2009).

M. Khayer, R. Lake, "Drive Currents and Leakage Currents in InSb and InAs Nanowire and Carbon Nanotube Band-to-Band Tunneling FETs," IEEE Electron Device Letters, 30, 12, 1257 - 1259, (2009).

N. Bruque, M. Ashraf, G. Beran, T. Helander, R. Lake, "Conductance of a Conjugated Molecule with Carbon Nanotube Contacts," Phys. Rev. B, 80, 155455(13), (2009).

M. Khayer, R. Lake, "Diameter Dependent Performance of High-Speed, Low-Power InAs Nanowire Field-Effect Transistors," Journal of Applied Physics, 107, 1, 014502(7), (2010).

J. Lin, D. Teweldebrhan, K. Ashraf, G. Liu, X. Jing, Z. Yan, R. Li, M. Ozkan, R. Lake, A. Balandin, C. Ozkan, "Gating of Single-Layer Graphene with Single-Stranded Deoxyribonucleic Acids," Small, 6, 10, 1150-1155, (2010).

M. A. Khayer and R. K. Lake, "Modeling and performance analysis of GaN nanowire field-effect transistors and band-to-band tunneling field-effect transistors," J. Appl. Phys. 108(10), 104503(7) (2010).

F. Zahid and R. K. Lake, "Thermoelectric properties of Bi2Te3 atomic quintuple thin films," Appl. Phys. Lett., 97, 212102 (2010).

M. K. Ashraf, N. A. Bruque, J. L. Tan, G. J. O. Beran, and R. K. Lake, "Conductance switching in diarylethenes bridging carbon nanotubes," J. Chem. Phys., 134, 024524(9) (2011).

K. M. M. Habib, F. Zahid, R. K. Lake, "Negative differential resistance in bilayer graphene nanoribbons," Applied Physics Letters, 98, 192112(3), 2011.

M. R. Neupane and R. K. Lake, "Core size dependence of the confinement energies, barrier heights, and hole lifetimes in Ge-core/Si-shell nanocrystals," J. Appl. Phys., 110, 7, 074306(6), 2011.

M. A. Khayer and R. K. Lake, "Effects of band-tails on the subthreshold characteristics of nanowire band-to-band tunneling transistors," J. Appl. Phys., 110, 7, 074508(6), 2011.

S. Upadhyayula, D. Bao, B. Millare, S. S. Sylvia, K. M. M. Habib, K. Ashraf, A. Ferreira, S. Bishop, R. Bonderer, S. Baqai, X. Jing, M. Penchev, M. Ozkan, C. S. Ozkan, R. K. Lake, V. I. Vullev, "Permanent Electric Dipole Moments of Carboxyamides in Condensed Media: What Are the Limitations of Theory and Experiment," J. Phys. Chem. B, 115, 9473-9490, 2011.

J. Khan, C. M. Nolen, D. Teweldebrhan, D. Wickramaratne, R. K. Lake, A. A. Balandin, "Anomalous electron transport in back-gated field-effect transistors with TiTe2 semimetal thin-film channels," Appl. Phys. Lett., 100, 4, 043109(4), 2012.

Selected Professional Development Activities

Participation in Conferences and Training:

1. UC Export Control training in 2011.
2. 2008 March Meeting of the American Physical Society, New Orleans, March 10-14, 2008.
3. International Electron Devices Meeting, San Francisco, CA Dec. 15-17, 2008.
4. Nanoelectronic Devices for Defense and Security Conference, Fort Lauderdale, FL, Sept. 28 - Oct. 2, 2009.
5. 37th Conference on the Physics and Chemistry of Surfaces and Interfaces, Sante Fe, NM, Jan. 10, 2010 - Jan. 14, 2010.
6. MRS Spring Meeting, San Francisco, CA, April 6-8, 2010.
7. Gordon Research Conference Electron Donor-Acceptor Interactions, Salve Regina University, Newport, RI, Aug 8 - 13, 2010.
8. 2011 March Meeting of the American Physical Society, Dallas, TX, March 21-25, 2011.
9. Spring Meeting of the MRS, San Francisco, CA, April 25-29, 2011.
10. International Symposium on Advanced Nanodevices and Nanotechnology, Dec. 4-9, 2011, Kaanapali, HI.

PING LIANG
Associate Professor, Department of Electrical Engineering

Education

Ph.D., Electrical Engineering, University of Pittsburgh	1987
M.S., Electrical Engineering, University of Pittsburgh	1984
B.E., Computer Science, Xi’an Jiaotong University	1982

Academic Experience

1987-1988	Researcher, University of California, Santa Barbara, CA.
1988-1991	Associate Professor, School of Computer Science Dalhousie University/Technical University of Nova Scotia, Halifax, Canada
1992-1995	Assistant Professor, Dept. of Electrical Engineering, University of California at Riverside, Riverside, CA
1995-1997	Electrical Engineering Program Leader, University of California at Riverside.
1995-present	Associate Professor, University of California at Riverside, Riverside, CA (On full time and part-time leave from July 1997 to June 2005)

Non-Academic Experience

1997-2005, Founder and CEO, TransDimension Inc., Irvine, CA.
As Founder and CEO of TransDimension Inc., I was responsible for technology and product development, and led the architecture and design of multiple wireless and wired communication ASIC and SOC chips and associated software stacks and drivers that supported various wired and wireless communication standards. ASIC chips, silicon IP cores and embedded system software I developed were used in products by Qualcomm, Motorola, Sony, HP, NEC, Samsung, etc. I also advised and consulted for other semiconductor startups in their ASIC and mixed signal designs.

Certifications or Professional Registrations

None

Current Memberships in Professional Organizations

OCTANE Entrepreneur Club

Honors and Awards

Outstanding Paper Award, 2nd IEEE Conf. Artificial Intelligence & Appl., Miami, FL, December 1985
Outstanding Paper Award, 3rd IEEE Int. Electr. Mfg.Tech. Symp., Anaheim, CA, October 12-14, 1987

Service Activities

2007-presentUndergraduate Advisor, Dept. of Electrical Engineering,University of California at Riverside, Riverside, CA

Selected Publications, Past 5 Years

Z. Zhao and P. Liang, "A Statistical Analysis of H.264/AVC FME Mode Reduction". IEEE Trans. Circuits Syst. Video Technology. 21(1): 53-61 (2011)

P. Liang, Z.L. Wu and J. Wang, System and method for USB controllers, US Patent 7,409,476, August 5, 2008

M. Chen and P. Liang, Recognition scheme for moderating wireless protocols, US Patent 7,277,451, October 2, 2007

M. Chen and P. Liang, Coordination architecture for wireless communication devices using multiple protocols, US Patent 7,233,602, June 19, 2007

M. Chen and P. Liang, Remotely-cooperative scheduling solution for moderating wireless protocols, US Patent 7,215,659, May 8, 2007

P. Liang and M. Chen, Universal printing system, US Patent 7,212,297, May 1, 2007

M. Chen and P. Liang, Collision rectification in wireless communication devices, US Patent 7,177,294, February 13, 2007

P. Liang and M. Chen, Centralized coordination point for wireless communication devices using multiple protocols, US Patent 7,167,484, January 23, 2007

Selected Professional Development Activities

UC Export Control training in 2011

NASA Senior Design and Systems Engineering Training, 2011

JIANLIN LIU

Professor, Department of Electrical Engineering

Education

Ph.D., Electrical Engineering, University of California, Los Angeles 2003
B.S., Physics, Nanjing University, China 1993

Academic Experience

1993-1997. Nanjing University, China. Graduate Research Assistant, Physics Department
1997-2003. University of California, Los Angeles. Staff Research Associate (1997-1999), Ph.D. candidate (1999-2003), Department of Electrical Engineering
2003-2008. University of California, Riverside. Assistant Professor of Electrical Engineering
2008-2010. University of California, Riverside. Associate Professor of Electrical Engineering
2010-present. University of California, Riverside. Professor of Electrical Engineering

Current Memberships in Professional Organizations

- Member of Institute of Electrical and Electronics Engineers (IEEE) (01/1999-present)
- Member of American Physics Society (APS) (01/2000-present)
- Member of Material Research Society (MRS) (01/2006-present)
- Member of International Society for Optical Engineering (SPIE) (01/2006-present)

Selected Honors and Awards

2010: SRC Inventor Recognition Award
2008: ARO Young Investigator Program (YIP) Award
2007: Faculty Development Award, UCR
2004: UC Regents' Faculty Fellowship, UCR
2001: PhD thesis is one of the 100 Excellent National PhD Theses of all discipline in China
1996: 1st Class Guang-Hua Award for excellent graduate student in research, Nanjing University
1995: 2nd Class Guang-Hua Award for excellent graduate student in research, Nanjing University
1994: 2nd Class Guang-Hua Award for excellent graduate student in research, Nanjing University

Service Activities

Professional service:
Journal paper reviewer
Proposal reviewer
Conference program committee member and conference organizer
Conference session chair

University service:
Member: UCR Materials Science and Engineering Building Committee (05/2004-09/2008)
Member: UCR MSE Building Clean Room Focus Group (05/2004-09/2008)

Member: UCR MSE Building Materials & Nanotechnology Lab Focus Group (05/2004-09/2008)
Member: BCOE MSE Program Curriculum Committee (01/2004-06/2005)
Director: BCOE Microelectronics Laboratory (07/2009-present)
Member: BCOE Scholarship Committee (01/2005-12/2005)
Member: CNSE Clean Room Staff Recruitment Committee (01/2006-09/2006)
Member: Electrical Engineering Undergraduate Committee/ABET Committee (10/2004-present)
Member: MSE Program Undergraduate Committee (04/2008-present)
Chair: Electrical Engineering Colloquia (07/2006-06/2007)

Selected Publications, Past 5 Years

Bei Li, Jianlin Liu, G. F. Liu, and J. A. Yarmoff, "Ge/Si heteronanocrystal floating gate memory", Appl. Phys. Lett. 91, 132107(2007)

Mario Olmedo, Alfredo A. Martinez-Morales, Gang Liu, Emre Yengel, Cengiz S. Ozkan, Chun Ning Lau, Mihrimah Ozkan, and Jianlin Liu, "Periodic alignment of Si quantum dots on hafnium oxide coated single wall carbon nanotubes", Appl. Phys. Lett. 94, 123109(2009)

Bei Li, Jingjian Ren and Jianlin Liu, "Synthesis of high-density PtSi nanocrystals for memory applications", Appl. Phys. Lett. 96, 172104(2010)

Mario Olmedo, Chuan Wang, Koungmin Ryu, Huimei Zhou, Jingjian Ren, Ning Zhan, Chongwu Zhou, and Jianlin Liu, "Carbon nanotube memory by the self-assembly of silicon nanocrystals as charge storage nodes", ACS Nano 5, 7972(2011)

Sheng Chu, Mario Olmedo, Zheng Yang, Jieying Kong, and Jianlin Liu, "Electrically pumped ZnO ultraviolet diode lasers on Si", Appl. Phys. Lett. 93, 181106(2008)

L. Li, Z. Yang, J. Y. Kong, and J. L. Liu, "Blue electroluminescence from ZnO based heterojunction diodes with CdZnO active layers", Appl. Phys. Lett. 95, 232117(2009)

Z. Yang, S. Chu, W. V. Chen, L. Li, J. Y. Kong, J. J. Ren, P. K. L. Yu, and J. L. Liu, "ZnO:Sb/ZnO:Ga Light Emitting Diode on c-plane Sapphire by Molecular Beam Epitaxy", Appl. Phys. Express 3, 032101(2010)

Sheng Chu, Guoping Wang, Weihang Zhou, Yuqing Lin, Leonid Chernyak, Jianze Zhao, Jieying Kong, Lin Li, Jingjian Ren and Jianlin Liu, "Electrically pumped waveguide lasing from ZnO nanowires", Nature Nanotechnology, 6, 506(2011)

Selected Professional Development Activities

UC Export Control training in 2011

ANASTASIOS MOURIKIS
Assistant Professor, Department of Electrical Engineering

Education

PhD, Computer Science	University of Minnesota	2008
Dipl. Eng., Electrical Engineering	University of Patras, Greece	2003

Academic Experience

Assistant Professor, Dept. of Electrical Engineering, University of California, Riverside, July 2008 – present.
Graduate Assistant, Dept. of Computer Science and Engineering, University of Minnesota, 2003-2008

Non-Academic Experience

Visiting Independent Advisor, NASA Jet Propulsion Laboratory, August 2006, July 2007.

Current Memberships in Professional Organizations

IEEE, IEEE Robotics Society, Technical Chamber of Greece

Honors and Awards

- Hellman Family Foundation Fellow, 2011-2012
- National Science Foundation, Award No. 1117957, "**Minimalistic Estimators for Navigation of Miniature Mobile Platforms,"** July 2011 – June 2014
- IEEE Transactions on Robotics, 2009 Best Paper Award (King-Sun Fu Memorial Award)
- UC Riverside, Regents' Faculty Fellowship Award, 2009-2010
- University of Minnesota, Best Dissertation Award Nominee, 2009
- University of Minnesota, Doctoral Dissertation Fellowship 2007-2008
- University of Minnesota Department of Computer Science and Engineering, Excellence in Research Award Fellowships, 2005 and 2006

Service Activities

- **Conference Organization**: Member of the International Program Committee for the 2009 and 2012 Robotics: Science and Systems conference
- **Reviewing: Journals**: IEEE Transactions on Robotics, International Journal of Robotics Research, Autonomous Robots, Journal of Field Robotics, Journal of Machine Vision and Applications, Journal of Intelligent and Robotic Systems, SIAM Journal on Matrix Analysis and Applications. Conferences: Robotics: Science and Systems, IEEE International Conference on Robotics and Automation (ICRA), IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Workshop on the Algorithmic Foundations of Robotics (WAFR), IEEE Conference on Decision and control (CDC),

IEEE International Conference on Intelligent Transportation Systems (ITSC), Canadian Conference on Computer and Robot Vision (CRV), International Conference on Advanced Robotics (ICAR)

Student Mentoring: Graduate advisor (past or present) for 3 Ph.D. students and 1 MS student. Research advisor (past or present) for 6 undergraduate students

Curriculum Development: Designed and introduced two graduate courses (EE 230, EE245) to the Electrical Engineering graduate curriculum at UC Riverside

Selected Publications, Past Five Years

N. Trawny, G. Huang, A.I. Mourikis, S.I. Roumeliotis: "Observability-based Consistent EKF Estimators for Multi-robot Cooperative Localization," *Autonomous Robots*, 30(1), pp. 99-122, January 2011.

G. Huang, A.I. Mourikis, S.I. Roumeliotis: "Observability-based Rules for Designing Consistent EKF SLAM Estimators," *International Journal of Robotics Research*, 29(5), pp. 502-528, April 2010.

A.I. Mourikis, N. Trawny, S.I. Roumeliotis, A. Johnson, A. Ansar, L. Matthies: "Vision-Aided Inertial Navigation for Spacecraft Entry, Descent, and Landing," *IEEE Transactions on Robotics*, 25(2), pp. 264-280, April 2009.

A.I. Mourikis, S.I. Roumeliotis, J.W. Burdick: "SC-KF Mobile Robot Localization: A Stochastic Cloning-Kalman Filter for Processing Relative-State Measurements," *IEEE Transactions on Robotics*, 23(4), pp. 717-730, August 2007.

A.I. Mourikis, N. Trawny, S.I. Roumeliotis, D.M. Helmick, L. Matthies: "Autonomous Stair Climbing for Tracked Vehicles," Vision and Robotics, Joint issue of the *International Journal of Computer Vision* and the *International Journal of Robotics Research*, 26(7), pp.737-758, July 2007.

A.I. Mourikis, S.I. Roumeliotis: "A Multi-state Constraint Kalman Filter for Vision-Aided Inertial Navigation," *Proceedings of the IEEE International Conference on Robotics and Automation*, April 10-14 2007, Rome, Italy, pp. 3565-3572.

Selected Professional Development Activities

UC Export Control training, 2011

Mihri Ozkan
Professor, Electrical Engineering

Education

Ph.D, Electrical and Computer Engineering, University of California at San Diego 2001
M.S., Materials Science and Engineering, Stanford University, Stanford, CA 1994
M.S., Metallurgical Engineering, University of Illinois at Urbana-Champaign, IL 1991
B.S., Metallurgical Engineering, Middle East Technical University, Ankara, Turkey 1988

Academic Experience

2009- present Professor, Electrical Engineering, UCR
2006- 2008 Associate Professor, Electrical Engineering, UCR
Fall 2001- 2006 Assistant Professor, Electrical Engineering, UCR

Non-Academic Experience
1995-1997 Process Development Engineer, Applied Materials Inc., Santa Clara, CA
1995-1994 Process Engineer, Analog Devices Inc., Santa Clara, CA
1/94-10/94 Co-op engineer, IBM Almaden Research Center, San Jose, CA

Current Memberships in Professional Organizations
MRS, AAAS, IEEE, AAUW, SWE

Honors and Awards

- Research Recognition Award, by the International Conference on New Trends in Nanotechnology, Ankara (2010)
- “National Medal for Engineering Science Young Investigator ”, by the Society of Engineering Science (2009)
- “Young Frontier in Engineering” Honor by the National Academy of Engineering (2008)
- “Finalist” Featured at the Bridge Magazine by the National Academy of Engineering (2008)
- “Inventor Recognition Award”, The Focus Center Research Program Global Research Collaboration (FCRP/GRC), Semiconductor Research Corporation (2008)
- “Young Investigator Award”, by the Army (2006)
- “Distinguished Engineering Educator of the Year Award” by the National Engineers’ Council (2006)
- “National Emerging Scholar Award” by the American Association of University Women (2005)
- “Nifty Fifty of San Diego’s Most Inspiring Scientist” Honor, by the San Diego Science Festival (2008-9)
- “2006 Referee of the Year” Award by the Journal of Biomedical Microdevices (2007)
- “Scientist in Nanotechnology Recognition” Award, Nanotechnology Workshop, by Bilkent University, Turkey (2006)
- “Visionary Science Award”, BioMEMS and Biomedical Nanotechnology Conference, Washington (2003)

- “Achievement in Technical Ingenuity” Award, Inland Empire Economic Partnership (2003)
- "Research Leadership Recognition Award" from CORE21 (2003)
- “Grand Award for the Graduate Research Poster”, Jacobs School of Engineering, San Diego (2002)
- “Graduate Student Award”, Biomedical Engineering Society, Seattle, WA (2000)
- “Graduate Student Silver Award”, by the Materials Research Society, Boston (Fall 1999)
- “Best Graduate Poster Award”, Jacobs School of Engineering, San Diego, (1998)

Selected Service Activities

2008-2010: Departmental Colloquium Organizer
2010-2011: Chair of the committee for recruitment of Board of Advisors
2010: Selected Graphene Symposium Organizer on Campus
2008: Member of new faculty mentorship program
2008: Chancellor’s Diversity Postdoctoral Fellowship Selection Committee
2009: Honor’s program committee
2011: Member of confidential performance committee assigned by the EVC

Selected Publications (more than 130 peer reviewed articles, 9 book chapters, 1 book)

RK Paul, M Ghazinejad, M Penchev, J Lin, M Ozkan, CS Ozkan, “Synthesis of a Pillared Graphene Nanostructure: A Counterpart of Three-Dimensional Carbon Architectures”, *Small*, vol 6, issue 20, pp 2309-2313, 2010

J Lin, D Teweldebrhan, K Ashraf, G Liu, X Jing, Z Yan, R Li, M Ozkan, RK Lake, AA Balandin, CS. Ozkan, “Gating of Single-Layer Graphene with Single-Stranded Deoxyribonucleic Acids”, *Small* ,Vol 6, Issue 10, pp 1150–1155, May 21 2010

J Lin, M Penchev, G Wang, RK Paul, J Zhong, X Jing, M Ozkan, CS Ozkan, “Heterogeneous Graphene Nanostructures: ZnO Nanostructures Grown on Large-Area Graphene Layers”, *Small*, Vol 6, issue 21, pp 2448-2452, 2010

K Galatsis, KL. Wang, M Ozkan, CS Ozkan, Y Huang, JP Chang, HG Monbouquette, Y Chen, P Nealey, Y Botros, “Patterning and Templating for Nanoelectronics”, *Advanced Materials*, Volume 22, Issue 6, pp 769–778, February 9, 2010

S.Chaudhary, H.Lu, A.Muller, C.Bardeen, M. Ozkan, "Hierarchical Placement and Associated Optoelectronic Impact of Carbon Nanotubes in Polymer-Fullerene Solar Cells," *Nano Letters*, 7, 7, pp1973-1979, 2007

X Wang, F Liu, GTS Andavan, X Jing, K Singh, VR. Yazdanpanah, N Bruque, RR. Pandey, R Lake, M Ozkan, KL Wang, CS Ozkan, “Carbon Nanotube–DNA Nanoarchitectures and Electronic Functionality”, *Small*, Volume 2, Issue 11, pp 1356–1365, November 2006

Singh K, Pandey R, Wang X, Lake R, Ozkan CS, Wang K, Ozkan M, "SWNT-PNA-SWNT Conjugates: Synthesis, Characterization and Modeling”, *Carbon*, 44, pp 1730–1739, 2006

Selected Professional Development Activities

2011 Member Of The Program Committee And Speaker: 2012 Cmos Emerging Technologies Workshop, July 18-20, 2012 and June 2011, Vencouver, Bc, Canada
2010 Member Of The Scientific Committee : New Trends In Nanotechnology And Nonlinear Dynamic Systems, July 25-27, 2010, Ankara, Turkey

WEI REN

Associate Professor, Department of Electrical Engineering

Education

Ph.D., Electrical Engineering, Brigham Young University, 2004
M.S., Electrical Engineering, Tongji University, 2000
B.S., Electrical Engineering, Hohai University, 1997

Academic Experience

2004-2005. Research Associate, Department of Aerospace Engineering, University of Maryland
2005-2010. Assistant Professor, Department of Electrical and Computer Engineering, Utah State University
2010-2011. Associate Professor, Department of Electrical and Computer Engineering, Utah State University
2011-present. Associate Professor II, Department of Electrical Engineering, UC Riverside

Certifications or Professional Registrations

None

Current Memberships in Professional Organizations

IEEE

Recent Honors and Awards

- Robins Award - Faculty Researcher of the Year, Utah State University, 2011
- Keynote Speaker, International Conference on Intelligent Unmanned System, 2010
- National Science Foundation CAREER Award, 2008
- Essential Science Indicators Fast Breaking Paper, 2007

Service Activities

- Associate Editor, Automatica, Systems and Control Letters, IEEE Control Systems Society Conference Editorial Board
- Member, IEEE Control Systems Society Technical Committee on Nonlinear Systems and Control (2009-present)

Selected Publications, Past 5 Years

W. Ren and Y. Cao, Distributed Coordination of Multi-agent Networks, Springer–Verlag, London, 2011.
W. Ren and R. W. Beard, Distributed Consensus in Multi-vehicle Cooperative Control, Springer–Verlag, London, 2008.

Y. Cao and W. Ren, "Distributed Coordinated Tracking with Reduced Interaction via a Variable Structure Approach," IEEE Transactions on Automatic Control, vol. 57, no. 1, January 2012, pp. 33-48.

W. Yu, G. Chen, W. Ren, J. Kurths, and W. Zheng, "Distributed higher-order consensus protocols in multi-agent dynamical systems," IEEE Transactions on Circuits and Systems Part I: Regular Papers, vol. 58, no. 8, August 2011, pp. 1924-1932.

Y. Cao, D. Stuart, W. Ren, and Z. Meng, "Distributed Containment Control for Multiple Autonomous Vehicles with Double-integrator Dynamics: Algorithms and Experiments," IEEE Transactions on Control Systems Technology, vol. 19, no. 4, July 2011, pp. 929-938.

W. Yu, W. Zheng, G. Chen, W. Ren, and J. Cao, "Second-order Consensus in Multi-agent Dynamical Systems with Sampled Position Data," Automatica, vol. 47, no. 7, July 2011, pp. 1496-1503.

J. Mei, W. Ren, and G. Ma, "Distributed Coordinated Tracking with a Dynamic Leader for Multiple Euler-Lagrange Systems," IEEE Transactions on Automatic Control, vol. 56, no. 6, June 2011, pp. 1415-1421.

Z. Meng, W. Ren, Y. Cao, and Z. You, "Leaderless and Leader-following Consensus with Communication and Input Delays under a Directed Network Topology," IEEE Transactions on Systems, Man, and Cybernetics (Part B), vol. 41, no. 1, February 2011, pp. 75-88.

Z. Meng, W. Ren, and Z. You, "Distributed Finite-time Attitude Containment Control for Multiple Rigid Bodies," Automatica, vol. 46, no. 12, December 2010, pp. 2092-2099.

Y. Cao and W. Ren, "Optimal Linear Consensus Algorithms: An LQR Perspective," IEEE Transactions on Systems, Man, and Cybernetics (Part B), Vol. 40, No. 3, June 2010, pp. 819-830.

Y. Cao, Y. Li, W. Ren, and Y. Chen, "Distributed Coordination of Networked Fractional-order Systems," IEEE Transactions on Systems, Man, and Cybernetics (Part B), Vol. 40, No. 2, April 2010, pp. 362-370.

W. Ren, "Distributed Cooperative Attitude Synchronization and Tracking for Multiple Rigid Bodies," IEEE Transactions on Control Systems Technology, Vol. 18, No. 2, March 2010, pp. 383-392.

W. Ren, "Consensus Tracking under Directed Interaction Topologies: Algorithms and Experiments," IEEE Transactions on Control Systems Technology, Vol. 18, No. 1, January 2010, pp. 230-237.

W. Ren, "Collective Motion from Consensus with Cartesian Coordinate Coupling," IEEE Transactions on Automatic Control, Vol. 54, No. 6, June 2009, pp. 1330-1335.

Y. Cao, W. Ren, and Y. Li, "Distributed Discrete-time Coordinated Tracking with a Time-varying Reference State and Limited Communication," Automatica, Vol. 45, No. 5, May 2009, pp. 1299-1305.

W. Ren, "Synchronization of Coupled Harmonic Oscillators with Local Interaction," Automatica, Vol. 44, No. 12, December 2008, pp. 3195-3200.

W. Ren, "On Consensus Algorithms for Double-integrator Dynamics," IEEE Transactions on Automatic Control, Vol. 53, No. 6, July 2008, pp. 1503-1509.

Selected Professional Development Activities

None

AMIT K. ROY-CHOWDHURY
Associate Professor, Department of Electrical Engineering

Education

University of Maryland, College Park, USAPhD (Electrical Engineering)	2002
Indian Institute of Science, Bangalore, India, Master of Engineering	1997
Jadavpur University, Calcutta, India Bachelor of Engineering	1995

Academic Experience
University of California, Riverside:
2009-present: Associate Professor, Department of Electrical Engineering
2004-2009: Assistant Professor, Department of Electrical Engineering
Cooperating Faculty, Dept. of Computer Science and Engineering
Member, Center for Research in Intelligent Systems
Member, Center for Plant Cell Biology
University of Maryland, College Park: Research Associate, Center for Automation Research, 2003
University of Maryland, College Park: Research Assistant, Dept. of Electrical and Computer Engineering/Center for Automation Research, 1998-2002
HRL Laboratories: Summer Research Internship, 2000
NEC Research Institute: Summer Research Internship, 1999

Non-Academic Experience

HRL Laboratories: Summer Research Internship, 2000
NEC Research Institute: Summer Research Internship, 1999
Motorola India Electronics Ltd: Software Development Engineer, 1997-98

Certifications or Professional Registrations

Current Memberships in Professional Organizations
Senior Member, IEEE

Honors and Awards
- Best Student Paper Award at ICASSP 2006 (received by his PhD student)
- Graduate Student Award, University of Maryland, College Park, 2002.
- Major Research Grants:

"Integrating Illumination, Motion and Shape Models for Video Analysis", National Science Foundation, Information and Intelligent Systems, 2007-2012.
"Distributed Dynamic Scene Analysis in a Self-Configuring Multimodal Sensor Network", Office of Naval Research, Mathematics, Computers and Information Research Division, 2009-2012.
"Wide-Area Cooperative Biometric/Tagging, Tracking and Locating in a Multimodal Sensor Network", Office of Naval Research, Information Systems Research Thrust Area, 2008-2011.
"Analysis of Complex Behaviors in Video", DARPA (sub to Mayachitra, Inc.), 2008 - 2012.
"An Intelligent Network of Wireless Videos for Dynamic Scene Analysis", National Science Foundation, Power, Controls and Adaptive Networks, 2006-2011.

Service Activities

- Associate Editor IEEE Trans. on Systems, Man and Cybernetics B, Machine Vision and Applications Journal; Section Editor for Elsevier Signal Processing e-reference; IEEE-MMTC Interest Group key member; Organizing committees of CVPR 2008 and ICIP 2008; Chief organizer of 1st IEEE Workshop on Camera Networks, 2010.
- Reviewer of most major journals in computer vision, image processing and pattern recognition, including IEEE Trans. on Pattern Analysis and Machine Intelligence, IEEE Trans. on Image Processing, IEEE Trans. on Signal Processing, IEEE Trans. on Multimedia, Proceedings of the IEEE, Computer Vision and Image Understanding. Member of Technical Program Committee or reviewer of CVPR, ICCV, ICIP, ICASSP, ICPR. Program committees of multiple workshops.
- Proposal review panels for NSF, ARO, Texas Higher Education Board, and book proposal reviewer for Springer and Wiley.
- Committee on Faculty Welfare, UCR Academic Senate
- ABET Coordinator, EE Dept.

Selected Publications, Past 5 Years

"Camera Networks - The Acquisition and Analysis of Videos OverWide Areas", A. Roy-Chowdhury, B. Song, Synthesis Lectures in Computer Vision, Morgan and Claypool Publishers, 2012

"Distributed Camera Networks: Integrated Sensing and Analysis for Wide Area Scene Understanding", B. Song, C. Ding, J. A. Farrell, A. Roy-Chowdhury, Signal Processing Magazine, May 2011.

"A Physics-Based Analysis of Image Appearance Models", Y. Xu, A. Roy-Chowdhury, IEEE Trans.on Pattern Analysis and Machine Intelligence, August 2011.

"Tracking and Activity Recognition Through Consensus in Distributed Camera Networks", B. Song, A. Kamal, C. Soto, C. Ding, J. Farrell, A. Roy-Chowdhury. IEEE Trans. on Image Processing, October 2010.

"Automated tracking of stem cell lineages of Arabidopsis shoot apex using local graph matching", M. Liu, R. Yadav, A. Roy-Chowdhury, G. V. Reddy, The Plant Journal, 2010.

"A "String of Feature Graphs" Model for Recognition of Complex Activities in Natural Videos", U. Gaur, Y. Zhu, B. Song, A. Roy-Chowdhury, IEEE Conf. on Computer Vision, 2011

"Cell Resolution 3D Reconstruction of Developing Multilayer Tissues from Sparsely Sampled Volumetric Microscopy Images", A. Chakraborty, R. Yadav, G. V. Reddy, A. Roy-Chowdhury, IEEE Intl. Conf. on Bioinformatics and Biomedicine, 2011

"A Stochastic Graph Evolution Framework for Robust Multi-Target Tracking", T. Jeng, E. Staudt, A. Roy-Chowdhury, European Conf. on Computer Vision, 2010.

"Inverse Compositional Estimation of 3D Pose And Lighting in Dynamic Scenes", Y. Xu and A. Roy-Chowdhury, IEEE Trans. on Pattern Analysis and Machine Intelligence, July 2008.

Selected Professional Development Activities

Attend major conferences in the area every year.

UC Export Control training 2011.

SHELDON TAN

Professor, Department of Electrical Engineering

Education

Ph.D., Electrical Engineering, University of Iowa	1999
M.S., Electronic Engineering, Fudan University, China	1995
B.S., Electronic Engineering, Fudan University, China	1992

Academic Experience

Assistant Professor, III, 7/1/2002
Assistant Professor, IV, 7/1/2004
Associate Professor, I, 7/1/2006
Associate Professor, III, 71/2008
Full Professor, II, 7/1/2010

Non-Academic Experience

Member of Technical Staff, Altera Corporation, San Jose, CA. 01/01 – 007/02
Member of Technical Staff, Monterey Design Systems, Sunnyvale, CA. 08/99 --01/01
Visiting Research Assistant, University of Washington, Seattle, WA. 09/98 – 05/99
Summer Intern, Avant! Corp. (now Synposys), Fremont, CA. 05/98 – 09/99
Summer Intern, Rockwell Semiconductor Systems, Newport Beach, CA. 07/97 – 09/97
Research Assistant, University of Iowa, IA. 09/96 – 09/98
Member of Faculty, Fudan University, Shanghai, China. 07/95 – 08/96

Current Memberships in Professional Organizations

Senior member of IEEE

Honors and Awards

Best Paper Award Nomination, 46th IEEE/ACM Design Automation Conference, Anaheim, CA, 2009.
Outstanding Oversea Investigator Collaboration Award, National Natural Science Foundation of China (NSFC), 2008.
COR (committee on research) Research Fellowship, UC Riverside, 2008.
Best Paper Award, IEEE Int. Conf. on Computer Design (ICCD), Lake Tahoe, CA, 2007
Best Paper Award Nomination, 42th IEEE/ACM Design Automation Conference, Anaheim, CA, 2005.
NSF CAREER Award, 2005.
UC Regent's Faculty Fellowship, 04-05, 06-07.
Best Paper Award, 36th IEEE/ACM Design Automation Conference, New Orleans, LA, 1999.
First Place Poster Award (Ph.D. Dissertation), The Annual Conference of the Center for Design of Analog-Digital Integrated Circuits (CDADIC), Seattle, WA, 1999.

Service Activities

Ad Hoc Committees (July, 2006 to present)
UCR EE Undergraduate Committee, Member (July 2007 to present)
BCOE, Computer Engineering Program Committee, **Co-Chair**, (Jan. 2008 – June, 2009)
UCR Campus-level Senate Committee on Committee, **member**, (July 2009 to June 2012)
UCR EE, Committee on External Relations and Development, member (July 2009 – present)
BCOE, Computer Engineering Program, **Associate Director** and **Undergraduate Advisor** (July, 2009 – present)
UCR EE, Faculty Search Committee, **Chair**, (July 2010 to June 2011)
UCR EE, Colloquium Organizer and Host, (Jan, 2011 to June 2011)

Editorial Board

- ACM Transaction on Design Automation of Electronic Systems (TODAE), Associate Editor, 2009 - 2012
- Integration, the VLSI Journal, Associate Editor, 2008 –
- Journal of VLSI Design, Associate Editor, 2006 – 2011

Technical Program Committee Members

- IEEE/ACM Design Automation Conference, (DAC), 2011
- IEEE International Conference on Computer-Aided Design (ICCAD), 2006-2007
- IEEE/ACM Asia and South Pacific-Design Automation Conference (ASPDAC), 2005-2009, 2012
- IEEE International Behavioral Modeling and Simulation Conference (BMAS), 2005-2006
- IEEE International Symposium on Quality Electronic Design, (ISQED), 2006-2010.
- IEEE International Conference on Computer Design (ICCD), 2010.

Selected Publications, Past 5 Years

Ruijing Shi, Sheldon X.-D. Tan and Hao Yu, *Statistical Performance Analysis and Modeling Techniques for Nanometer VLSI Designs*, Springer Publishing 2012

D. Li, S. X.-D. Tan, E. H. Pacheco, M. Tirumala, "Parameterized architecture-level thermal modeling for multi-core microprocessors", *ACM Transaction on Design Automation of Electronic Systems* (TODAES), vol. 15, no. 2, pp.1-22, February 2010 (one of top 10 downloaded ACM TODAES Articles published in 2010)

B. Yan, S. X.-D. Tan, L. Zhou, J. Chen, R. Shen, "Decentralized and passive model order reduction of linear networks with massive ports", *IEEE Transactions on Very Large Scale Integrated Systems* (TVLSI), 10.1109/TVLSI.2011.2126612

See http://www.ee.ucr.edu/~stan/publication_list.html for complete publication list

Selected Professional Development Activities

UC Export Control training in 2011

ERTEM TUNCEL
Associate Professor, Department of Electrical Engineering

Education

- PhD, Electrical and Computer Engineering, UC Santa Barbara 2002
- MS, Electrical and Electronics Engineering, Bilkent University, Turkey 1997
- BS, Electrical and Electronics Engineering, Middle East Technical University, Turkey, 1995

Academic Experience

- 2003-2005. Assistant Professor II, Department of Electrical Engineering, UCR.
- 2005-2007. Assistant Professor III, Department of Electrical Engineering, UCR.
- 2007-2009. Assistant Professor IV, Department of Electrical Engineering, UCR.
- 2009-2011. Associate Professor II, Department of Electrical Engineering, UCR.
- 2011-Current. Associate Professor III, Department of Electrical Engineering, UCR.

Current Memberships in Professional Organizations

- Member of IEEE.

Honors and Awards

- 2007 NSF CAREER Award: Low-delay communication in sensor networks via prediction- and transform-based distributed source coding.
- 2005 and 2009 UC Regents' Faculty Fellowship/Faculty Development Award.
- Ranked 2nd in the Department of Electrical and Electronics Engineering, Middle East Technical University, and 3rd among the class of 1995 (over 2500 students).
- Ranked 97th in the nation among over a million students in Turkish national university entrance examinations.

Service Activities

- Graduate advisor of Electrical Engineering for the academic years 2008-2009, 2009-2010, and 2011-2012.
- Member of Executive Committee of Bourns College of Engineering, years 2006-2009.
- Member of UCR's Academic Integrity Committee, academic year 2007-2008.
- Member of UCR's Graduate Council, academic year 2011-2012.
- Technical Program Committee member for IEEE International Conference on Communications, May 2005, for IEEE GLOBECOM, Washington D.C., November 2007, and for IEEE International Symposium on Information Theory, July 2009.
- Reviewed journal papers submitted to IEEE Transactions on Information Theory, IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE Transactions on Communications, and IEEE Transactions on Automatic Control.

Selected Publications, Past 5 Years

Y. Gao and E. Tuncel, *"Wyner-Ziv coding over broadcast channels: Hybrid digital/analog schemes,"* IEEE Transactions on Information Theory, pp. 5660-5672, September 2011.

X. Chen and E. Tuncel, *"Low-delay prediction- and transform-based Wyner-Ziv coding,"* IEEE Transactions on Signal Processing, pp. 653-666, February 2011.

Y. Gao and E. Tuncel, *"New hybrid digital/analog schemes for transmission of a Gaussian source over a Gaussian channel,"* IEEE Transactions on Information Theory, pp. 6014-6019, December 2010.

J. Nayak, E. Tuncel, D. Gunduz, and E. Erkip, *"Successive refinement of vector sources under individual distortion criteria,"* IEEE Transactions on Information Theory, pp. 1769-1781, April 2010.

J. Nayak, E. Tuncel, and D. Gunduz, *"Wyner-Ziv coding over broadcast channels: Digital schemes,"* IEEE Transactions on Information Theory, pp. 1782-1799, April 2010.

J. Nayak and E. Tuncel, *"Successive coding of correlated sources,"* IEEE Transactions on Information Theory, pp. 4286-4298, September 2009.

E. Tuncel, J. Nayak, P. Koulgi, and K. Rose, *"On complementary graph entropy,"* IEEE Transactions on Information Theory, pp. 2537-2546, June 2009.

E. Tuncel, *"Capacity/storage tradeoff in high-dimensional identification systems,"* IEEE Transactions on Information Theory, pp. 2097-2106, May 2009.

F. Altiparmak, E. Tuncel, H. Ferhatosmanoglu, "*Incremental maintenance of online summaries over multiple streams,"* IEEE Transactions on Knowledge and Data Engineering, pp. 216-229, February 2008.

E. Tuncel, *"Kraft inequality and zero-error source coding with decoder side information,"* IEEE Transactions on Information Theory, pp. 4810-4816, December 2007.

B. Song, E. Tuncel, A. K. Roy-Chowdhury *"Towards a multi-terminal video compression algorithm by integrating distributed source coding with geometrical constraints,"* Journal of Multimedia, pp. 9-16, June 2007.

H. Ferhatosmanoglu, E. Tuncel, D. Agrawal, and A. El Abbadi, *"High dimensional nearest neighbor searching,"* Elsevier Information Systems Journal, pp. 512-540, September 2006.

E. Tuncel, *"Slepian-Wolf coding over broadcast channels,"* IEEE Transactions on Information Theory, pp. 1469-1482, April 2006.

E. Tuncel, *"On error exponents in hypothesis testing,"* IEEE Transactions on Information Theory, pp. 2945-2950, August 2005.

Selected Professional Development Activities

UC Export Control training in 2011

ALBERT WANG
Professor, Department of Electrical Engineering

Education

Ph.D., State University of New York, Buffalo, NY, USA	1996
M.S., The Chinese Academy of Science, China	1988
B.S., Tsinghua University, Beijing, China	1985

Academic Experience
1998-2003. Assistant Professor, Department of Electrical and Computer Engineering, Illinois Institute of Technology, Chicago, IL
2003-2007. Associate Professor, Department of Electrical and Computer Engineering, Illinois Institute of Technology, Chicago, IL
2007-2012. Professor, Department of Electrical Engineering, University of California, Riverside

Non-Academic Experience
1995-1998, Staff Engineer, National Semiconductor Corp., USA,

Honors and Awards
- Fellow, AAAS, 2011.
- The Chancellor's Award for EUR, Univ. of California, Riverside, 2010.
- Fellow, IEEE, 2009.
- Fulbright Specialist Roast, 2009.
- Outstanding Overseas Young Scholar Award, NSF of China, 2007.
- Chunhui Outstanding Overseas Scholar, Ministry of Education of China, 2006.
- Inaugural Sigma Xi Award for Excellence in University Research, IIT, 2003.
- National Science Foundation CAREER Award, 2002.
- IEEE Distinguished Lecturer, IEEE Electron Device Society, 2002 - Present.
- IEEE Distinguished Lecturer, IEEE Solid-State Circuit Society, 2001 - 2008.

Service Activities
- President-Elect, IEEE Electron Devices Society, 2012 – Present,
- Secretary, IEEE CAS ASPTC Committee, 2011-Present.
- Vice President, IEEE Electron Device Society, 2006–2012.
- ExCom member, IEEE EDS, 2006-Present.
- Committee, International Technology Roadmap for Semiconductors (ITRS), 2007–Present.
- Member, IEEE EDS VLSI Technology and Circuits Committee, 2002-present
- Member, IEEE CAS Analog Signal Processing Technical Committee (ASPTC), 2006-.
- IEEE TAB MGA Board, 2010-present
- IEEE-USA Government Relations, R&D Policy Committee, 2010-present
- Conference Committee: IEEE IEDM, CICC, RFIC, RWW, BCTM, ICSICT, ASICON, IEDST, ISCAS, IEW, IRPS, ICUWB, EDSSC, ISTC, MIEL, ICEMAC, AP-RASC, ASP-DAC, NewCAS, APC-CAS, etc.

Editorship

- Editor, IEEE Electron Device Letters, 2003 – 2012
- Associate Editor, IEEE Transactions on Circuits & Systems I, 2003-2007, 2010–Present.
- Guest Editor, IEEE Journal of Solid-State Circuits, 2009, 2004, 2005.
- Guest Editor-in-Chief, IEEE Trans. Electron Devices, Special Issue for RF ICs, 2004.
- Associate Editor, IEEE Transaction on Circuits and Systems II, 2003.

Selected Publications, Past 5 Years (from more than 180 papers)
Book:

Albert Wang, *On-Chip ESD Protection for Integrated Circuits – An IC Design Perspective,* Kluwer Academic Publishers, Boston, 2002, ISBN: 0-7923-7647-1.

Papers:

J. Zhan, A. Wang, et al, "Stacked-Spiral RF Inductor with Vertical Nano-Powder-Magnetic-Core in CMOS", *IEEE Microwave and Wireless Components Letters, Vol. 22, No. 1*, pp29-31, January 2011.

J. Liu, Albert Wang, et al, "Design and Analysis of Low-Voltage Low-Parasitic ESD Protection for RF ICs in CMOS", *IEEE J. Solid-State Circuits, V46, N5,* pp.1100-1110, May 2011.

X. Wang, Albert Wang, et al, "A Whole-Chip ESD-Protected 0.14pJ/p-mV 3.1-10.6GHz Impulse-Radio UWB Transmitter in 0.18µm CMOS", *IEEE Trans. Microwave Theory and Techniques, V59, N4,* pp.1109-1116, April 2011.

L. Lin, Albert Wang, et al, "Novel Nanophase-Switching ESD Protection", *IEEE Electron Device Letters, V32, N3*, pp.378-380, March 2011.

X. Wang, Albert Wang, et al, "ESD-Protected Power Amplifier Design in CMOS for Highly Reliable RF ICs", *IEEE Trans. Industrial Electronics, V58, N7,* pp2736-2743, July 2011.

B. Qin, Albert Wang, et al, "1.8pJ/pulse Programmable Gaussian Pulse Generator for Full-Band Non-Carrier Impulse UWB Transceivers in 90nm CMOS", *IEEE Trans. Industrial Electronics,V57, N5*, pp. 1555-1562, May 2010.

X. Wang, A. Wang, et al, "Cross-Coupling Low-Triggering Dual-Polarity CLTdSCR ESD Protection in CMOS", *IEEE Electron Device Letters, Vol. 31, No. 10,* pp.1143-1145, October 2010.

H. Xie, Albert Wang, et al, "A 52mW 3.1-10.6GHz Fully Integrated Correlator for IR-UWB Transceivers in 0.18µm CMOS", *IEEE Trans. Industrial Electronics,V57, N5,* pp. 1546-1554, May 2010.

C. Yang, Albert Wang, et al, "Investigation of on-Chip Soft-Ferrite-Integrated Inductors for RF ICs — Part I: Design and Simulation", *IEEE Trans. Electron Devices, Vol. 56, No. 12,* pp. 3133-3140, December 2009.

C. Yang, Albert Wang, et al, "Investigation of on-Chip Soft-Ferrite-Integrated Inductors for RF ICs — Part II: Experiments", *IEEE Trans. Electron Devices, Vol. 56, No. 12,* pp. 3141-3148, December 2009.

L. Zhang, A. Wang, et al, "Unipolar Resistive Switch Based on Silicon Monoxide Realized by CMOS Technology", *IEEE Electron Device Letters, Vol. 30, No. 8,* pp.870-872, August 2009.

C. Yang, A. Wang, et al, "Ferrite-Integrated on-Chip Inductors for RF ICs ", *IEEE Electron Device Letters*, *Vol. 28, No. 7,* pp652-655, July 2007.

ZHENGYUAN “DANIEL” XU
Professor, Department of Electrical Engineering

Education

Ph.D., Electrical Engineering, Stevens Institute of Technology, NJ	1999
M.S., Electronic Engineering, Tsinghua University, China	1991
B.S., Electronic Engineering, Tsinghua University, China	1989

Professional Experience

7/09–present, Professor, Dept. of Electrical Engineering, University of California, Riverside, CA.
7/09–present, Director, Center for Ubiquitous Communication by Light (UC-Light), University of California, CA.
10/06–3/07, Visiting Associate Professor, STAR Lab, Department of Electrical Engineering, Stanford University, CA.
7/05–7/09, Associate Professor, Dept. of Electrical Engineering, University of California, Riverside, CA.
7/99–6/05, Assistant Professor, Dept. of Electrical Engineering, University of California, Riverside, CA.
8/91–7/96, System Engineer, Tsinghua Unisplendour Corp., Tsinghua University, China.

Research Interest

Wireless communications and related signal processing. Topics of interest include communication theory, detection and estimation theory, spread spectrum and ultra-wideband wireless technology, optical wireless communication, ranging and localization, ad-hoc and wireless sensor networking, and applied mathematics in electrical engineering.

Selected Publications

Z. Dong, K. Cui, G. Chen, and Z. Xu, “Non-line-of-sight link performance study for indoor visible light communication systems,” Proc. of SPIE, San Diego, CA, August 1-3, 2010.
K. Cui, G. Chen, Z. Xu, and R. D. Roberts, “Line-of-sight visible light communication system design and demonstration,” Proc. of 7th IEEE, IET International Symposium on Communication Systems, Networks & Digital Signal Processing, Newcastle, UK, July 21-23, 2010.
B. Bai, Z. Xu, and Y. Fan, “Joint LED dimming and high capacity visible light communication by overlapping PPM,” Proc. of WOCC, Shanghai, China, May 14-15, 2010.
K. Cui, G. Chen, Q. He, and Z. Xu, “Indoor optical wireless communication by ultraviolet and visible light,” Proc. of SPIE, San Diego, CA, August 2-3, 2009.
L. Wang, Y. Li, and Z. Xu, “On connectivity of wireless ultraviolet networks,” J. Opt. Soc. Am. A (JOSA A), vol. 28, no. 10, pp. 1970-1978, October 2011.
H. Ding, Z. Xu, and B. M. Sadler, “A path loss model for non-line-of-sight ultraviolet multiple scattering channels,” EURASIP Journal on Wireless Communications and Networking, vol. 2010, Article ID 598572, pp. 1-12, June 2010.

G. Chen, Z. Xu, and B. M. Sadler, "Experimental demonstration of ultraviolet pulse broadening in short-range non-line-of-sight communication channels," Optics Express, vol. 18, no. 10, pp. 10500-10509, May 2010.

L. Wang, Z. Xu, and B. M. Sadler, "Non-line-of-sight ultraviolet link loss in non-coplanar geometry," Optics Letters, vol. 35, no. 8, pp. 1263-1265, April 2010.

H. Ding, G. Chen, A. Majumdar, B. M. Sadler, and Z. Xu, "Modeling of non-line-of-sight ultraviolet scattering channels for communication," IEEE Journal on Selected Areas in Communications, vol. 27,no. 9, pp. 1535-1544, December 2009.

G. Chen, Z. Xu, H. Ding, and B. M. Sadler, "Path loss modeling and performance trade-off study for short-range non-line-of-sight ultraviolet communications," Optics Express, vol. 17, no. 5, pp.3929-3940, March 2009.

Awards and Honors

2001 – 2010 UC Academic Senate Research Award

2001, 2003, 2005 UC Regents' Faculty Award

1999 Peskin Award, Stevens Institute of Technology, NJ

1991 Motorola Scholarship, Tsinghua University, China

Professional Activities

Elected member, "Signal Processing for Communications" Technical Committee, IEEE Signal Processing Society, 2004 – 2009.

Guest Editor

IEEE Journal of Selected Topics in Signal Processing, 2006-2007.

Associate Editor

IEEE Trans. on Signal Processing (2006 – 2009).

IEEE Trans. on Vehicular Technology (2002 – 2006).

IEEE Communications Letters (2002 – 2005)

General Chair/Co-Chair

IEEE Globecom 2011 Workshop on Optical Wireless Communications, Houston, Texas, December 5-9, 2011.

IEEE Globecom 2010 Workshop on Optical Wireless Communications, Miami, Florida, December 6-10, 2010.

NSF Optical Wireless Applications Workshop, State College, PA, June 8-10, 2010.

ARO/ARL Workshop on Ultraviolet Devices and Communication Systems, College Park, Maryland, April 23, 2008.

Technical Program Committee Chair/Co-Chair

MIMO Systems Symposium, International Wireless Communication and Mobile Computing Conference (IWCMC), Greece, August 2008; Honolulu, August 2007.

Student Supervision

Supervised 13 Master and Ph.D. students. Some of them were employed by university and top industry in related fields after their graduation.

QI ZHU
Assistant Professor, Department of Electrical Engineering

Education

Ph.D., Electrical Engineering and Computer Sciences, University of California, Berkeley, 2008
M.S., Electrical Engineering and Computer Sciences, University of California, Berkeley, 2006
B.E., Computer Science and Technology, Tsinghua University 2003

Academic Experience

2011 – Present, Assistant Professor III, Department of Electrical Engineering, University of California, Riverside

Non-Academic Experience

2008 – 2011, Research Scientist, Strategic CAD Laboratories, Intel Corporation

Current Memberships in Professional Organizations

Member, Institute of Electrical and Electronics Engineers (IEEE)
Member, Association for Computing Machinery (ACM)

Honors and Awards

- Design Automation Conference Best Paper Award, 2007, 2006
- Pao Family Fellowship from University of California, Berkeley, 2003

Service Activities

- Graduate Committee, Department of Electrical Engineering, UCR, 2011 – 2012
- Technical Program Committee, IEEE/ACM Design Automation Conference (DAC), 2012
- Technical Program Committee, IEEE International Conference on Parallel and Distributed System (ICPADS), 2012
- Technical Program Committee, IEEE Real-time and Embedded Technology and Applications Symposium (RTAS), 2012
- Technical Program Committee, IEEE/ACM International Conference on Formal Methods and Models for Codesign (MemoCODE), 2012
- Technical Program Committee, IEEE International Symposium on VLSI Design, Automation and Test (VLSI-DAT), 2010 – 2012
- Technical Program Committee, IEEE International Conference on Embedded Software and Systems (ICESS), 2011

Selected Publications, Past 5 Years

Qi Zhu, Yang Yang, Marco Di Natale, Eelco Scholte and Alberto Sangiovanni-Vincentelli, "Optimizing the Software Architecture for Extensibility in Hard Real-Time Distributed Systems", *IEEE Transactions on Industrial Informatics (TII)*, Vol. 6, No. 4, pp. 621-636, November, 2010.

Qi Zhu, Nathan Kitchen, Andreas Kuehlmann and Alberto Sangiovanni-Vincentelli, “SAT Sweeping with Local Observability Don’t-Cares”, in *Advanced Techniques in Logic Synthesis, Optimizations and Applications*, Sunil P. Khatri and Kanupriya Gulati, Editors, Springer, 2010.

Yang Yang, Alessandro Pinto, Alberto Sangiovanni-Vincentelli and Qi Zhu, “A Design Flow for Building Automation and Control Systems”, 31st IEEE Real-Time Systems Symposium (RTSS'10), San Diego, CA, December, 2010.

Qi Zhu, Yang Yang, Eelco Scholte, Marco Di Natale and Alberto Sangiovanni-Vincentelli, “Optimizing Extensibility in Hard Real-time Distributed Systems”, 15th IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS'09), San Francisco, CA, April, 2009.

Qi Zhu, Abhijit Davare and Alberto Sangiovanni-Vincentelli, “A Formal Approach for Optimizing Mapping in System Level Design”, TECHCON 2008, Austin, TX, November, 2008.

Wei Zheng, Qi Zhu, Marco Di Natale and Alberto Sangiovanni-Vincentelli, “Definition of Task Allocation and Priority Assignment in Hard Real-Time Distributed Systems”, 28th IEEE Real-Time Systems Symposium (RTSS'07), Tucson, Arizona, December, 2007.

Abhijit Davare, Qi Zhu, Marco Di Natale, Claudio Pinello, Sri Kanajan and Alberto Sangiovanni-Vincentelli, “Period Optimization for Hard Real-time Distributed Automotive Systems”, 44th IEEE/ACM Design Automation Conference (DAC'07), San Diego, California, June, 2007. (Best Paper Award)

Note to ABET evaluators: Sharon Burton is not full time staff at UCR. But for the last 5 years she has co-taught ENGR 180: Technical Communications.

Sharon Burton

3055 Priscilla Street, Riverside CA 92506

951-202-0813 or 951-369-8590 *sharon@sharonburton.com*

Skills	**Strong skills in**: content strategy, content management, social media; technical communication, user-centered content development, social marketing campaigns, social media ROI, market research; project management and scheduling; classroom, virtual, and onsite training and training material development; content creation, technical writing, management, publishing, and workflow; product evangelism, public speaking **Computer skills**: GoToWebinar/GoToMeeting, Microsoft Office, FrameMaker, MadCap Flare, RoboHelp, Author-it, Acrobat, Visio, HTML, CSS, Twitter, HootSuite, Google Analytics, online document and traditional book publishing **Education**: PhD candidate in Cultural Anthropology, University of California, Riverside, ABD with emphasis on communities and economics; Bachelors of Science, Cultural Anthropology, University of California, Riverside, emphasis on communities and economics
Career Highlights	• Wrote *8 Steps to Amazing Webinars*, available on Amazon and bn.com • Advised clients and customers on creating and implementing content development strategies • Increased product leads and sales by creating successful free webinar series • Leveraged social media to increase buzz for products and company • Reduced support costs for consumer products by up to $500,000 a year • Created products that improve life for the customer
Awards and Honors	• Identified as 18th most influential person about technical communication and content strategy by Mindtouch. Full list at http://www.mindtouch.com/blog/2012/01/06/techcomm-contentstrategy-400-knowledgebase/ • Inducted as an Associate Fellow of the Society for Technical Communication • Awarded honors for manuals, websites, e-books, and online help

Experience
2011-present

Content Strategist Independent Consultant

- Support clients to select the right tools for unique workflows, including advising best practices to import/convert/use legacy content
- Identify and solve workflow issues
- Product training, including Flare, Author-it, and others
- Writing user documents for clients

2010 – 2011

Product Evangelist Author-it, Auckland NZ

Created a series of highly successful educational webinars in a variety of content development topics, resulting in 1500 new leads, with a qualification rate of 30%.

Innovated social media to support branding and generate product buzz. For example, increased Twitter following from 60 to over 600. Created a product-specific LinkedIn group with over 300 users in 10 months. Wrote and directed marketing content, including website, blog, show collateral, and articles. Increased blog traffic by 400%.

Developed marketing campaigns, analyzed market trends, and directed the marketing message.

Ran product trainings, rewrote the training materials, and increased trainee satisfaction with the materials.

2009 – 2010

Technical Communication Consultant Independent Contractor/Self-Employed

Consulting expert, including:

- Writing user documents for clients
- Product training
- Recommend cost-effective and custom workflows

Provide writing and content conversion support

2007-2009

Product Manager/Product Evangelist MadCap Software, La Jolla CA

Represented the company at industry events, including demonstrating products and soliciting customer response.

Supported the sales staff with presales activities, including online demos, travel to customer sites, and responding to RFPs.

Created a series of highly successful educational webinars in a variety of technical communication topics.

Analyzed industry trends, predicted product adoption rates, managed press relations, developed marketing campaigns, and drove products to meet market needs.

Innovated social media uses to support branding and generate product buzz.

2005-2007 **Manager, Technical Publications** Wonderware, Lake Forest CA

- Hired to improve quality of product documentation for industrial automation products, with the goal of supporting the user experience.
- Introduced and implemented writing standards and content strategy that reduced localization costs for product documents. Resulting documents eased simultaneous international product release bottleneck.
- Trained and managed 13 salaried and contract international writers for the 400+ product documents in the library.
- Established project planning, designed and administered user surveys, created and implemented documentation planning and process, and educated departments in the importance of product documentation. Increased user satisfaction by ~20%.

2003-2004 **Technical Writer** Safetran Systems, Rancho Cucamonga CA

- Wrote user and reference manuals for train signaling equipment.
- Developed online help for signals software and script-based standup training manuals.
- Designed customer surveys and, using the research data, led the Tech Pubs group in rewriting existing user documentation to be more task-based and less feature-based, while supporting the customer's needs and regulatory requirements.
- Helped the writers meet deadlines, supporting them in developing graphics, and generating solid PDF files for CD and web distribution.
- Moved Tech Pubs from Word to FrameMaker and WebWorks Publisher to more efficiently develop user documentation.

Additional Professional Activities

- Teach Technical Communication and Scientific Writing to undergraduate and graduate Engineering students at the University of California, Riverside (10 years)
- Teach Business Writing for the University of Redlands (one year)
- Teach working professionals advanced topics for the Society for Technical Communication (180 months)

Note to ABET evaluators: Bonni Graham is not full time staff at UCR. But for the last 5 years she has co-taught ENGR 180: Technical Communications

Bonni Graham

Summary of qualifications

I am the Senior Manager, Marketing Communication - Commercial for Scantron Corporation, where I plan and develop marketing and social media strategy and tactics. Previously, I led a team that planned, developed, and maintained a complete suite of end-user documentation (user guides, help systems, job aids, training materials, etc.)

I owned and operated a technical documentation business from 1994 to 2009. Our core offerings included technical manual preparation for a variety of industries, policy and procedure documents, and online help and curriculum development deliverables.

I have lectured for two University of California campuses (Riverside and San Diego) since 2003. My instructor ratings are always high, and I receive emails from students regularly expressing how much they appreciate what they've learned from my classes.

As a speaker, I have always garnered the highest ratings from conference attendees; I was in the 90th percentile of speaker scores at LavaCon 2003-2009, WinWriters 2002 & 2008, InfoProducer 2001, InfoStrategies 2001, and each of the STC Annual Conferences where I have presented. STC chapters throughout California, and in Washington, Hawaii, Arizona, Texas, and India have rated me highly.

Professional experience

2012 - Present GlobalScholar/Scantron Corporation Bellevue, WA

Senior Manager, Marketing Communication - Commercial

Create market strategy and tactics for Scantron Commercial Group data capture and analysis products covering markets like employee safety, surveys, and government. Design and produce marketing collateral and sales support materials. Drive market thought leadership through our social media presence.

2005 – 2012 Scantron Corporation Irvine, CA

Senior Manager, User Experience & Documentation

Prepare end-user documents & training materials for Scantron products ranging from K-12 assessment & diagnostic tools to survey applications to OMR scanners; coach and train staff on proper documentation procedures and quality standards; determine working group strategy and planning.

2003 - Present University of California Riverside & San Diego, CA

Lecturer

Present curriculum material for both online and in-person classes on technical communication. Subjects covered: Intro to Technical Communication/Technical Communication I, Policies and Procedures, Critical Thinking for Technical

Communicators, Webinar Skills for Technical Communicators, project Management for Technical Communicators, ENG180W: Technical Communication.

1994 - Present Manual Labour, Inc San Diego, CA

President/CEO

Determine business strategy, tactics, and direction for technical publications outsourcing; coach and train staff writers at all levels (from entry-level to senior, experienced staff); develop and deliver training in proprietary standard document development process and methodology for internal staff; prepare compelling sales and marketing materials; present service solutions to prospects and clients.

1993 - 1994 ENFIN Technology Labs San Diego, CA

Technical Writer

Prepare technical manuals, including: writing, editing, indexing, graphic development, audience analysis, usability testing of product and manuals.

1990 - 1993 Data Trek, Inc San Diego, CA

Technical Writer

Prepare technical manuals, including: writing, editing, indexing, graphic development, audience analysis, usability testing of product and manuals.

Additional professional activities: Articles & Presentations

Selected Articles published and presented

- *How to Build a Business Case*, co-authored with Jack Molisani, published in STC's Intercom, July/August 2008 issue
- *Building a Business Case: Demonstrating Added Value to Clients and Employers; How to Speak CEO: and Other Corporate Language Skills; Using Historical Data To Estimate, Bid, and Manage Documentation Projects*
  Presentation slides published 2003-2009 LavaCon, The International Conference on Technical Project Management, currently hosted on Manual Labour Inc's web site (http://www.manuallabour.com/symposia)
- *Corporate 101: Understanding the Role Technical Communicators Play in Business; Document to the Question: Understanding what users ask and where they look for the answers*
  Presentation slides published in the *Proceedings* for the 2003 STC India Chapter 5th Annual Conference
- *Identity Crisis; The Persona as a Tool for Creating and Evaluating Information Design*
  Presentation slides published 2002 WinWriter's Annual Conference, currently hosted on Manual Labour Inc.'s web site (http://www.manuallabour.com/symposia)
  Presented at approximately 7 STC chapter meetings and at the 2000 STC Annual Conference
- *Management by Leveraging Your Personality Flaws (presented as The Beast With Two Brains)*
  Presentation slides published 2001 InfoStrategies Conference Proceedings
  Presented under original title at approximate 5 STC chapter meetings

Additional professional activities: Awards

Professional and Honor Society Awards

- Harland Clarke Holding Company Pillar Award: Customer Focus
- Southern California STC Spotlight Competitions Award of Excellence for *Scantron Leadership Academy Handbook-*
- Southern California STC Spotlight Competitions Award of Excellence for *Scantron Achievement Series and Performance Series API Guide*
- Southern California STC Spotlight Competitions Award of Merit for *Class Climate CD case set*
- Harland Clarke Holding Company Idea Challenge, 2nd place in Scantron for *iForms: Electronic Scantron Test Forms for Mobile Devices*
- **Associate Fellow**, Society for Technical Communication
- Communications Concepts Award of Excellence in Training Manuals for *Item Development Training Manual*
- Communications Concepts Award of Excellence in Hardware & Software Manuals for *Achievement Series Job Aid set*
- Southern California STC Spotlight Competitions Award of Excellence

for *Proctoring Performance Series Tests Documentation Set*

Professional memberships

- Associate Fellow, Society for Technical Communication (STC); served on Board of Directors as Director-Sponsor for Region 8 (representing CA, HI, NV, Australia, and New Zealand)
- Member, International Executive's Guild
- Senior Member, National Association for Female Executives

Education

University of California at San Diego

Bachelor of Arts Literature/Writing

University of California at Los Angeles (Extension)

Online Instructor Development Training (certificate of completion)

Appendix C: Equipment

LOCATIONS: WINSTON CHUNG HALL 121, 125, 126, 128, 221

All EE lab computers (except WCH 126) run Windows 7 with the following software installed: Atmel AVR Studio, Cadence SPB, Codewarrior IDE, Digilent Adept, Hapsim, Matlab, Microchip MPLAB C32, Microchip MPLAB IDE, Microchip PICkit 2, MS Office, MS Visual Studio, Realterm, and Xilinx ISE Design Studio.

Additionally computing resources that support students are three *NIX computational servers that are available anytime for students. These computational servers have the following programs installed for instructional support: Mathematica 8, Matlab, Cadence IC 5141, Cadence IC 610, Sentaurus TCAD, Agilent ADS, Agilent EMPRO, Agilent ICCAP, and Synopsys HSPICE.

The EE Shop provides hands on support of tool use and equipment. The students receive further guidance on equipment use with equipment orientation documents and help from the TA. The students receive guidance of computing resources from the lab manuals.

EE maintains a schedule of approximate dates for lab equipment upgrades. Upgraded hardware must meet the minimum specifications for the courses/labs taught, software requirements, and hardware interaction. Software upgrades must work with the current labs being taught. Additionally, computers must meet the minimum hardware requirements as required by the software. Both hardware & software upgrades are done in a non-disruptive process. This usually occurs during summer before the beginning of the fall quarter.

WCH 121 (Instruction Lab: Available to students only during lab.)		
INSTRUMENT/MANUFACTURER - WCH 121	**LABS**	**QUANTITY**
19inch LCD monitors	WCH 121	16
Intel Core2 Duo E7200 @ 2.53 GHz w/ 4 GB RAM & 80 GB HD computers	WCH 121	16
HP 54600B Oscilloscope	WCH 121	16
HP 33120A Waveform Generator	WCH 121	16

HP E3630A Power Supply	WCH 121	16
HP 34401A Meter	WCH 121	16
WCH 125 (Instruction Lab. Available to students from 8am to 10 pm daily) Computers and Monitors upgraded in 2011		
Wch 125 also has 5 computers installed with an Nvidia Quadro 2000 graphics card. This card is used for an upper division EE Course in parallel coputing. These computers include the following additonal software: Nvidia 3D Vision, Nvidia CUDA Toolkit & SDK, NVidia GPU Computing SDK, and NVidia Parallel Nsight.		
INSTRUMENT/MANUFACTURER - WCH 125	**LABS**	**QUANTITY**
21-23 inch LCD wide-screen monitors	WCH 125	30
Intel Core i5-2400 @ 3.10 GHz w/ 3 GB RAM and 250 GB HD	WCH 125	16
Intel Core i3-2100 @ 3.10 GHz w/ 3 GB RAM and 250 GB HD	WCH 125	14
NVidia Quadro 2000 PCI-X graphics cards (installed in 5 lab computers).	WCH 125	5
WCH 126 (Instruction Lab: Available to students only during lab and 24/7 for senior design.)		
Due to older hardware restrictions to support the ECP Model 205 Torsional Plants, WCH 126 computers run Windows XP with a smaller subset of the software mentioned above.		
INSTRUMENT/MANUFACTURER - WCH 126	**LABS**	**QUANTITY**
17inch LCD monitors, Pentium 4 3.0GHz CPU, 512MB RAM, 40 GB HD computers	WCH 126	16
Tektronix TDS420A Oscilloscope	WCH 126	16
A15:E27HP 33120A Waveform Generator	WCH 126	16

INSTRUMENT/MANUFACTURER - WCH 126 (con't…)	**LABS**	**QUANTITY**
Power Supply	WCH 126	16
Fluke 45 Meter	WCH 126	16
ECP Model 205 Torsional Plants	WCH 126	12
ECP Model 205 ISA computer control cards	WCH 126	9
ECP Model 205 PCI computer control card	WCH 126	1
WCH 128 (Instruction Lab: Available to students only during lab.) Computers and Monitors upgraded in 2011		
INSTRUMENT/MANUFACTURER - WCH 128	**LABS**	**QUANTITY**
21inch LCD monitors	WCH 128	16
Intel Core 2 Duo E6750 @ 2.66 GHz w/ 2 GB RAM & 80 GB HD computers	WCH 128	16
Agilent DSO3102A Oscilloscope	WCH 128	16
Agilent 33210A Waveform Generator	WCH 128	16
HP E3630A Power Supply	WCH 128	16
HP 34401A Meter	WCH 128	16
WCH 221 (Computational Lab. Available to students 24/7.) Computers and Monitors upgraded in 2011		

INSTRUMENT/MANUFACTURER - WCH 221	LABS	QUANTITY
16 of Dell E2011H 20-inch Widescreen LCD monitors	WCH 221	16
16 of Pentium D 2.80GHz CPU, 1GB RAM, 80GB Hard drive	WCH 221	16

Appendix D: Institutional Summary

1. The Institution

a. University of California, Riverside
(Legal name: The Regents of the University of California)
900 University Avenue
Riverside, CA 92521

b. Name and title of the chief executive officer of the institution added 2/10/12
Timothy P. White, Chancellor

c. Name and title of the person submitting the self-study report. Added 2/10/12
Reza Abbaschian, Dean, Bourns College of Engineering

d. Name the organizations by which the institution is now accredited and the dates of the initial and most recent accreditation evaluations. Added 2/28/12

The University of California, Riverside, is accredited by the Western Association of Schools and Colleges (WASC). UCR was most recently accredited on March 3, 2010. WASC reaccreditation occurs approximately every 10 years, and UCR's next proposal for reaccreditation is due to be submitted to WASC in fall 2016.

Other accreditations at UCR include:

Graduate School of Education, accredited by the California Commission on Teacher Credentialing. Reaccreditation is under way now; a report is due in fall 2012, and the next site visit is expected to be in 2014. Further, the GSOE School Psychology program is being reaccredited in 2012. A site visit was in March 2012, and a decision is due in August 2012.

The Chemistry Department is reviewed by the American Chemical Society. The Chemistry department provides annual reports and 5-year reports on curriculum and student performance. The most recent 5-year report was in June 2010.

The School of Business Administration (SoBA) will begin its AACSB Maintenance of Accreditation in 2012-13, with a site visit expected in January 2013.

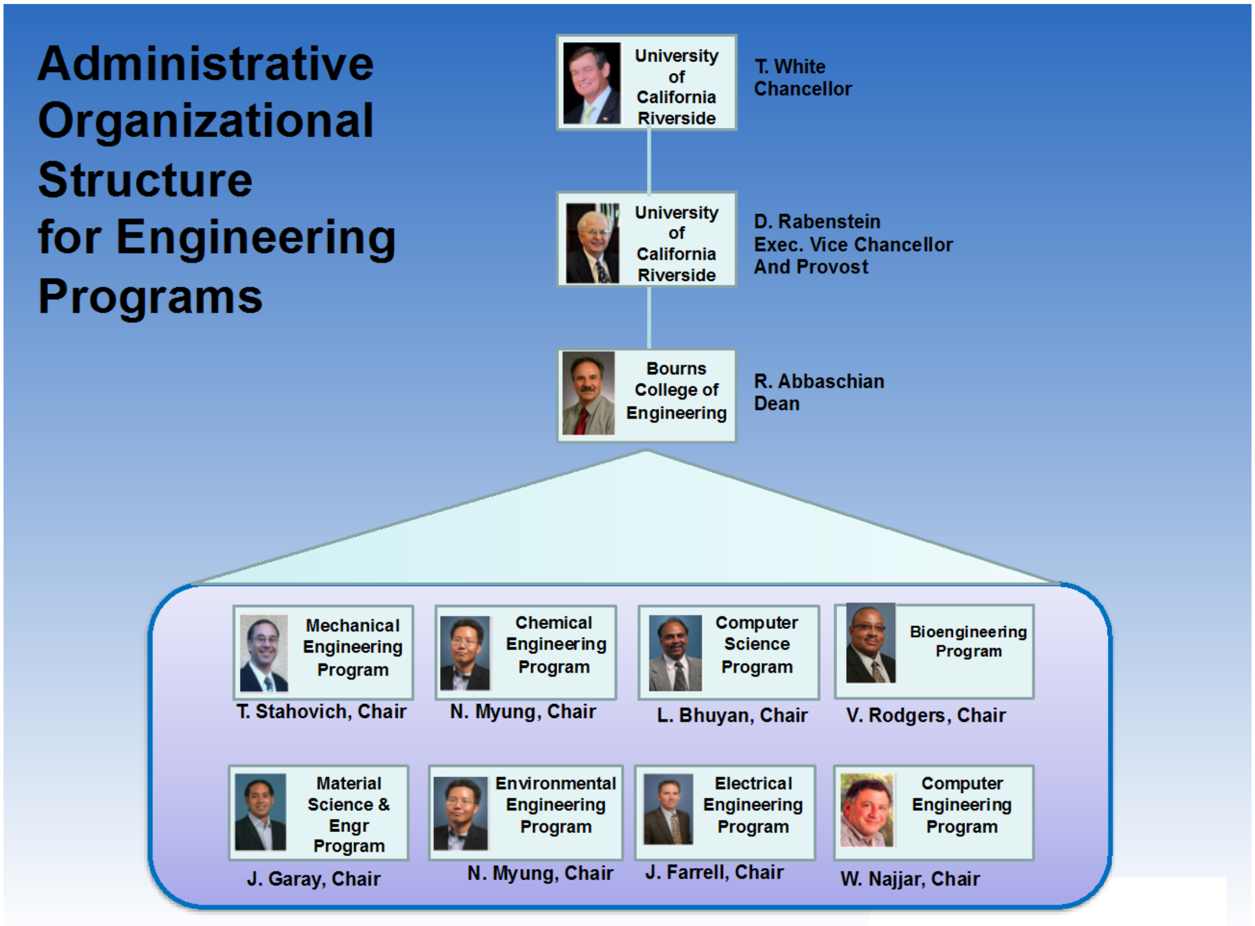
The UCR School of Medicine was denied initial accreditation by the Liaison Committee on Medical Education (LCME) in June 2011 because of budget uncertainties. The University expects to reapply this year with a new funding model that is less reliant on state funds.

2. Type of Control

The University is a state-controlled institution of higher education and an accredited Hispanic Serving Institution (HSI).

3. Educational Unit

The following chart describes the program organizational structure for the Bourns College of Engineering. Each program chair reports to the Dean of the College, who reports to the Vice Chancellor and Provost, who reports to the Chancellor of the UC Riverside Campus. The program chairs shown on the top line of the college section are also Department Chairs.



4. Academic Support Units

Department or Unit	Responsible Individual	
	Name	**Title**
Biochemistry	Richard Debus	Chair
Bioengineering	Victor Rodgers	Chair
Biology	Bradley Hyman	Chair
Chemical & Environmetal Engineering	Nosang Myung	Chair
Chemistry	Eric Chronister	Chair
Computer Science	Laxmi Bhuyan	Chair
Electrical Engineering	Jay Farrell	Chair
English	Deborah Willis	Chair
Math	Vyjayanthi Chari	Chair
Mechanical Engineering	Thomas Stahovich	Chair
Physics	Jory Yarmoff	Acting Chair
Statistics	Daniel Jeske	Chair

5. Non-academic Support Units

UCR Libraries: Dr. Ruth Jackson, University Librarian
Computing & Communications: Charles J. Rowley, Associate Vice Chancellor & Chief Information Officer, C&C Associate Vice Chancellor
Learning Center: Michael P. Wong, Director
Career Center: Sean Gil, Director

6. Credit Unit

The UC Riverside academic year consists of three quarters, each with 10 weeks of instruction followed by a week of final exams. Each quarter credit represents one hour of instruction. Three laboratory hours also represent one credit. One hour of additional discussion represents one credit.

7. Tables

Table D-1. Program Enrollment and Degree Data
Electrical Engineering

	Academic Year		Enrollment Year					Total Undergrad	Total Grad	Degrees Awarded			
			1st	2nd	3rd	4th	5th			Associates	Bachelors	Masters	Ph.D.
Current Year	2011-12	FT	70	83	43	36	14	246	114	N/A			
		PT	0	1	3	1	1	6	1				
2010-11		FT	98	49	43	17	16	223	139	N/A	35	35	23
		PT	0	2	0	2	1	5	1				
2009-10		FT	66	54	29	24	16	189	134	N/A	26	30	8
		PT	1	1	0	0	1	3	0				
2008-09		FT	62	35	29	18	25	169	123	N/A	34	27	12
		PT	0	0	1	1	2	4	0				
2007-08		FT	42	36	24	40	26	168	94	N/A	49	23	12
		PT	0	1	2	1	3	7	2				

Give official fall term enrollment figures (head count) for the current and preceding four academic years and undergraduate and graduate degrees conferred during each of those years. The "current" year means the academic year preceding the fall visit.

FT--full time
PT--part time

Table D-2. Personnel

Electrical Engineering

Year[1]: Fall 2011

	HEAD COUNT		FTE
	FT	PT	
Administrative[4]			
Faculty (tenure-track)	22	1	22.10
Other Faculty (excluding student Assistants)	6	7	7.32
Student Teaching Assistants[2]	4	20	14.00
Student Research Assistants[3]	38	30	53.00
Technicians/Specialists	2	2	3.00
Office/Clerical Employees	2	11	3.68
Others[5]	2	0	2.00

[1] Data on this table should be for the fall term immediately preceding the visit. Updated tables for the fall term when ABET team is visiting are to be prepared and presented to the team when they arrive.

[2] For student teaching assistants, Full-time equals 25% or more.

[3] For graduate students, 1 FTE equals 49% or more. (Does not include self-support or fellowships)

[4] Persons holding joint administrative/faculty positions or other combined assignments should be allocated to each category according to the fraction of the appointment assigned to that category.

5 Assistant Deans, Directors/Managers, Specialist, Deputy Director, MSO/FAOs, Analyst IV, Student Affairs Officers III/IV, & Public Info Rep.

Legend for Table D-2
Personnel and Students
Bourns College of Engineering

Figures collected from:	Bioengineering Department Chemical and Environmental Engineering Department Computer Sciences & Engineering Department Electrical Engineering Department Mechanical Engineering Department Material Sciences & Engineering Program
Administrative:	Dean and Associate Deans (Mark Matsumoto and Chinya Ravishankar counted as .50 FTE each)
Faculty (tenure-track and tenured)	All faculty (excludes the Dean and Associate Deans' 50% appointments)
Other Faculty (excluding student Assistants)	Lecturers Adjunct Professors Professional Research Series (visiting and non-visiting titles) Postgraduates/Visiting Postdoctoral Researchers Junior Specialists Readers
Student Teaching Assistants:	All Graduate Teaching Assistants (25% or more considered full-time)
Student Research Assistants	All Graduate Student Researchers (49% or more considered full-time) and Associate In ____ Data gathered using payroll – does not include self-support or fellowships
Technicians/Specialists:	Development Engineers Programmer Analysts Staff Research Associates Laboratory Helpers and Assistants Physical Plant Superintendents
Office/Clerical Employees:	Senior Analyst (Dean's Executive Assistant-E. Montoya) Assistant Analysts and Analysts Student Affairs Officers III & Student Affairs Officers I & II Computer Resource Spec. II Student Assistants I & II

<u>Others</u>	Assistant Deans Directors & Managers (Functional Area) Admin/Coord/Officer (Functional Area) Specialist (Functional Area) Deputy Director (CE-CERT) Management Service Officers (MSOs) Administrative Specialist (N. Jahr) Prin. & Senior Administrative Analysts Student Affairs Officers III & IV (Asst. Director & Director of MESA) Senior Writer

Appendix E: Meeting Minutes

PART A: FACULTY MEETING MINUTES

The following contains samples from Faculty Meeting Minutes from 2008-2012 that are most closely related to ABET. More detailed minutes will be available for review.

FALL 2008 – SPRING 2009

10-30-2008 MEETING

1) ABET:
   a) Dr. Amit Roy-Chowdhury, Chair of EE Accreditation and Assessment Committee, presented for consideration and feedback, a quantitative methodology for measuring Program Objectives (POs). The methodology will conform to ABET requirements while eliminating the current weighting system; thus streamlining and providing a more definitive measure of POs. The precise details are yet to be worked out.
   b) <u>R. Lake noted that many of the ABET folders for last year were missing or incomplete. Approaches to enforce ABET compliance were discussed. It was suggested that ABET compliance be included in the evaluation of teaching during merit and promotion cases. J. Chen noted that such a consideration might conflict with the Call. It was then suggested to include it in the evaluation of service, and to make ABET compliance a minimum threshold for acceptable service.</u>

11-13-2008 MEETING

2) <u>ABET Compliance</u>
   a) Roger Lake asked members for options for policing ABET compliance by faculty members; what consequences, what rewards, if any? No clear decision was agreed upon.

03-04-2009 MEETING

3) <u>Computer Science & Engineering Technical Elective – "Mobile Wireless Networks"</u>
   a) Discussion
   b) Vote: 12 In-Favor; 0 Opposed; 0 Abstain
4) <u>EE Development Activities</u>
   a) Discussion regarding development activities for the department
   b) Lack of development activities cited in both program reviews
   c) Contemplating forming a EE faculty development committee
   d) Call for suggestions of committee members and chair

04-01-2009 MEETING

5) <u>Computer Engineering Program</u> – Walid Najjar/Sheldon Tan
   a) Based on comments from undergraduate program review the dean formed a committee to resolve issues. Committee consisted of Walid, Frank Vahid, Sheldon Tan and Albert Wang. Other UC campuses were researched and it was discovered most distinguish themselves as Computer Engineering "programs" versus Computer Engineering "majors". UCSB was cited as the model. Their set-up included a director and associate director with a 25% administrative staff person from each department. No stipend is given to the director and associate director, just course relief.

b) A vote was called for the department to endorse with moving forward with the proposal. Tally: 15, In-Favor; 0, Opposed; 0, Abstained

6) EE 20 "Circuit and System Analysis and Design using MATLAB" – Ping Liang
   a) In response to undergraduate and ABET reviews the need for more programming and linear algebra exists in the curriculum. A course title needs to be decided upon; faculty is requested to submit suggestions to Ping and he will report on the final decision for the name.
   b) A vote was called for the department to continue the effort for this new course. Tally: 15, In-Favor; 0, Opposed; 0, Abstained

05-01-2009 MEETING

7) Discussion of Action/Implementation Plan of EE Undergraduate Program Review
   a) Phase I of Action/Implementation Plan: Conduct faculty meeting for discussion of results and plan for implementation of recommended actions
   b) Faculty were advised by the chair to:
      i) Ensure Lab Manuals are updated and current as required;
         (1) Contact Elmar Palma for electronic documents/lab manuals
      ii) Faculty are to drop in, observe lab sessions and make themselves available to students;
      iii) Synchronize labs to lecture to the extent possible. Faculty is to inform students of importance of completing pre-lab work before the lab;
      iv) Faculty advised to encourage all students to take advantage of Office Hours.
         (1) Discussion ensued on a possible orientation-mixer event to encourage faculty-student interaction which would encourage students to attend Office Hours.
   c) For ABET a form for lab instruction sign-on will be developed for use to monitor continuous process improvement. Amit will develop and deploy the form.
   d) The above items (a-c) cover recommendations 6, 7, 8 and 15 with spring 2009 timeline.
   e) Recommendations 1, 3 and 4 were determined by the faculty to be College level action items; Roger will follow-up with Ravi on progress in these areas; spring 2009 timeline (NOTE: CEP accepts department response for recommendation 4, item closed).
   f) EE 20 will need to replace an existing course; campus has declined to drop English 1C as a requirement; CS61 was identified as a potential course to drop. Sheldon will consult with Frank Vahid and report back to Roger.
   g) Active learning and use of flex classrooms (Interactive Learning Classroom). Faculty informed to make use of flex classrooms as much as possible; Point of Contact (POC) is Gladis Herrera-Berkowitz X2-4751. Faculty identified as having experience using the flex classrooms:
      i) Ward Beyermann, Physics
      ii) Frank Vahid, CS&E
      iii) Len Mueller, Chemistry
      iv) Sasha and Amit have had classes assigned, but did not have need of the technology for those particular courses.
      v) Ward Beyermann will conduct seminars on utilizing these resources. Roger will obtain information and pass on to faculty
      vi) The above items (f and g) cover recommendation 5 spring 2010 timeline.
      vii) Recommendations 11 and 14; spring/fall 2009 timeline: complaint regarding course load credit for EE 175A/B. Ravi and Roger to investigate and determine remedy, as needed.

FALL 2009- SPRING 2010

11-06-2009 MEETING

8) Discussion on NSF-IGERT Courses
   a) The option that the IGERT courses be erased when IGERT expires was discussed. No decision was made.
9) It was decided that new courses will not be voted on via email; they will be voted on at Faculty Meetings. It was suggested that minor changes to courses continue to be voted on via email.
10) Discussion and Vote on Course EE 2XX: Mathematical Methods for Electrical Engineers
   Voted unanimously all in favor by 14 faculty members (Balandin, Barth and Ozkan left the meeting early and did not vote).

11-20-2009 METTING

1. Undergraduate review compliance report. (Amit, Roger)
   a.) Discussion
   b.) Voting: all in favor
2. Graduate review response. (Ertem, Roger)
   a.) Discussion
   b.) Edited responses
   c.) **Action Item**: Continue to discuss and edit responses.
3. ABET (Amit)
   a.) Amit discussed changing the way we measure outcomes.

01-08-2010 MEETING

4. Graduate Review Response.
   a.) Discussion
   b.) Vote: Unanimously approved by all.
5. Undergraduate Review Response.
   a.) Discussion.
   b.) Discussion on updating lab improvement item in ABET folders.
6. Course Revision for EE 260.
   a.) Discussion on changing from 4 units to variable (min 1-max 4).
   b.) Vote: 10 in favor, 1 abstain
   Agenda items moved to next meeting:
1. Discuss ABET-Focused Academic Checks form

Administrative Announcements

ABET Accreditation due 2012; the committee will look at Fall 2009 through Spring 2012.

01-15-2010 MEETING

7. Undergraduate Review Response.
   c.) Discussion.
   d.) Discussion on updating lab improvement item in ABET folders.
8. Discussion on ABET-Focused Academic Checks form.

03-12-2010 MEETING

1. ABET
   a. End of Course Student/Instructor Assessments for winter quarter are due

b. CEP Undergraduate Program Review Final Report due in April; follow-up on action item, "laboratory visits by instructors" please document this on your Assessments
c. Winter Quarter ABET Checklist will be at the Reception Desk in the EE Administrative Suite; please sign-off so it can be returned to Tim Willette in the Dean's Office

04-23-2010 MEETING

1. Discussion and Approve final report to CEP for the undergraduate program review
   All in favor

04-30-2010 MEETING

9. Discussion of *EE Final Report on Implementation of the Action/Implementation Plan: Electrical Engineering Undergraduate Program Review of May 31, 2008*

10. Discussion and Approve: Remove prerequisite EE 236 to course EE 211
    a. All in favor

05-07-2010 MEETING

1. Discussion of *EE Final Report on Implementation of the Action/Implementation Plan: Electrical Engineering Undergraduate Program Review of May 31, 2008*

05-14-2010 MEETING

1. Discussion and Vote: EE 245 Revision
   a. Unanimous approval to change prerequisite of EE 236 from EE 235 to EE 215
   b. Unanimous approval to change EE 245 (EE 236 will be prerequisite); catalog description will be revised.
   c. Suggestion made to teach EE 236 in winter quarter

FALL 2010 – SPRING 2011

10-29-2010 MEETING

1. Discussion and vote on new courses:
   a. EE 123 Power Electronics (effective Fall 2011) [12 In Favor; 0 Opposed; 0 Abstain]
   b. EE 153 Electric Drives (effective Winter 2012) [12 In Favor; 0 Opposed; 0 Abstain]
   c. EE 217 GPU Architecture and Parallel Programming
   (effective Spring 2012) [12 In Favor; 0 Opposed; 0 Abstain]

Adrienne is handling academic program matters, including ABET

11-05-2010 MEETING

1. ABET
   Amit Roy-Chowdhury discussed new metrics method of determining course outcome results
2. Discussion and vote on EE 247
   13 In Favor; 0 Opposed; 0 Abstained

11-12-2010 MEETING

1. Discussion and vote of EE 238 Linear Multivariable Control to Cross list EE 235 and ME 235 prerequisite
    a. In Favor 12; Opposed 0; Abstain 0
    b. Add under grading “S/NC with instructor permission”
2. Discussion and vote of EE 239 Optimal Control to cross list EE 235 and ME 235 prerequisites and revise description
    a. In Favor 12; Opposed 0; Abstain 0
    b. Add under grading “S/NC with instructor permission”

FALL 2011- WINTER 2012

08-22-2011 MEETING

NONE

09-09-2011 MEETING

11. Department Goals and Objectives
    a. Graduate Program
        i. UCOP Funding; UCOP is being used as a fund of last resort, faculty will support grad students with contract and grant funds, IC, IAA, gift, TA and as last resort, UCOP
        ii. Discussion on formal oral defense
        iii. Discussion to revise written exam
        iv. Change time until second chance exam
        v. Review sequence of courses and catalog descriptions
        vi. Discussion of TA allocations
    b. Undergraduate Program
        i. EE 175 to expand to three quarters; consultation with Ping Liang required
        ii. Review sequence of courses and catalog descriptions

11-14-2011 MEETING

12. Ertem Tuncel presented graduate program discussion
    a. Course change for EE 215: In Favor – 17; Oppose – 0; Abstain - 0
13. Ping Liang presented EE 175 Sr. Design Course change to three quarters:
    a. The change was proposed based on the evaluations by faculty of the senior design project course in the last several years. It was observed that most student groups barely have enough time to complete their design projects in two quarters. Since the senior design project was offered in the last two quarters of the senior year, students rush to complete their final reports in a few days and the reports were often not as detailed or well written even if they did a very good project. Furthermore, after the faculty evaluated the final reports, the students had already graduated and left campus. There was no time for the faculty to mark up the final reports and provide feedback for the student to revise and improve their final reports. This is not how technical documents are produced in engineering practices. Therefore, we propose to change the current EE175A (4 units) and EE175B (4 units) offered in the Winter and Spring quarters of senior year to EE175A (3 units), EE175B (4 units) and EE175C (1 unit) offered in the Fall, Winter and Spring quarters of the senior year. Students are still

required to complete the design projects in two quarters. The third quarter of EE175C is used to give students sufficient time to reflect upon their design experience, write a thorough technical report, and to have at least one round of editing and improvement in which the faculty mark up the reports and provide feedback and the students improve based on the faculty feedback. The faculty discussed whether 1 unit was sufficient for 175C and agreed that we needed to keep the design activity to the first two quarters and 175C is only for reflection, summary and writing up the report and have feedback improvement process. Thus, 1 unit is justified.

b. The change incorporates the following:

   i. Fall Qtr EE 175A (3); Winter Qtr EE 175B (4); Spring Qtr EE 175 (1)

   ii. Vote for change of EE 175: In Favor - 13; Oppose - 1; Abstain - 3

c. Based on feedback from students and past data, we believe that early involvement of undergraduate students in engineering courses help students better understand and develop interest in engineering. EE20 was introduced based on this consideration and we have seen positive results. The undergraduate committee and the Chair have been evaluating additional ways to move more engineering courses to the first two years. As a result of this effort, we have obtained agreement from CS to offer CS10-CS13(or CS12)-CS61 in the fall, winter and spring of freshmen year. This will allow EE to move more EE courses into the sophomore year. Ping Liang presented information on the revised recommended course plan based on these changes.

d. Ping Liang presented information on coming change to course plan:

		CURRENT				CHANGE	
QTR	FALL	WINTER	SPRING		FALL	WINTER	SPRING
FROSH		10	12		10	12	61
SOPH	61	120A	120B		120A	120B	
JR/SR	128						128

e. Sheldon Tan presented request to have CS 168 Intro to VLSI Design cross-listed.
   i. Vote: In Favor – 17; Oppose – 0; Abstain - 0
f. Jay Farrell advised all faculty to keep in contact with Cherysa to ensure their case-file is moving forward

12-07-2011 MEETING

14. Discussion regarding poor performance of TAs; department must send clear message of expectations and act swiftly to remove TAs not meeting expectations.
15. Future discussion to be announced regarding change in TA allocation formula and faculty workload criteria. Dean is asking departments to consider reducing lab instruction in order to lower TA costs.
    a. Explore possibility of using undergraduates as Reader/Graders to lower costs

01-25-2012 METTING

16. Discussion and vote of Course Change Proposal for EE 020
    i. Adding CS 10 as a prerequisite
    ii. Changing catalog text to read:

6. Introduces MATLAB programming and linear methods for engineering analysis and design. Topics include formulating engineering problems as linear systems of equations; methods for finding their solutions; vector and matrix representations of signals and systems; matrices computations; and linear programming for system analysis and design.

02-01-2012 MEETING

17. ABET Briefing and discussion presented by Amit Roy-Chowdhury, EE ABET Chair:
    a. Review of last ABET findings and action taken
    b. Discussed Program Educational Objectives; faculty felt they did not require any changes.

Discussed Student Outcomes and the evaluation process

03-21-2012 MEETING

Bill Bingham

18. Jay Farrell called meeting to order
19. Review and approved minutes of 02/29/2012 and 03/14/2012 meetings
20. ABET Briefing presented by Amit Roy-Chowdhury
    a. Review is this year
    b. Course files must be in order
    c. Continuous Improvement Process is critical component of the review
    d. First draft of self-study report due end of this month
    e. Final draft of self-study report due to Dean's Office (D.O.) end of May
    f. Final report due to ABET June 30^{th}
21. Discussion and vote of Ozkan Accelerated Merit case file
22. Discussion and vote of Korotkov Merit case file

04-04-2012 MEETING

1. ABET Briefing presented by Amit Roy-Chowdhury regarding Continuous Process Improvement (CPI): Amit presented a flowchart outlining the CPI (Continuous Process Improvement) system for EE courses. ABET requires an emphasis on CPI, not just collection of documents. The documents provide proof of a continuous process improvement system in place. ABET is looking for two criteria to be satisfied: (1) Student Outcomes to be achieved by graduation; and (2) Program Educational Objectives to be achieved a few years post-graduation. The CPI should address both these criteria.

Jay will work with Danny, EE Systems Administration, to provide alumni with lifetime e-mail account.

5-16-12 MEETING

1. Amit Roy-Chowdhury presented, Undergraduate Program Curriculum Discussion:

PEOs:

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

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

success in a chosen profession or vocation as evidenced by:
- career satisfaction
- promotions/raises (e.g. management leadership positions or distinguished technical positions)
- professional visibility (e.g., publications, presentations, patents, inventions, awards)
- professional responsibilities (e.g. professional registration, professional mentoring, professional society membership and offices)
- entrepreneurial activities
- consulting activities

contributions to society as evidenced by:
- Leadership roles
- Public service
- Mentoring / outreach activities
- Volunteer service

Expectation Level: With advice from the BOA and faculty, it has been decided that minimum expectation level is the attainment of at least one of the evidence bullets in two categories. Catalog changes will be initiated to reflect this in the future.

Analysis of PEOs:

- There did not seem to be any major issues related to career satisfaction or the preparation received while at UCR.

- Among the students who chose an industry career, the vast majority were working in engineering related areas, where their academic preparation was most useful.
- About 50% of the alumni who responded to the survey pursued graduate studies, which was deemed to be very satisfactory.
- Whether in higher studies or in industry, a good number of the alumni felt that they were contributing positively as evidenced by publications, presentations, patents, awards, etc.
- About one-third of the alumni surveyed were involved in the community. Some of them have come back to mentor and give seminars to our current students.
- The Senior Design Project was very highly appreciated. It was felt that the role of community involvement and ethical responsibilities could be highlighted more in the senior design projects, given the high interest in this course among the students.
- Some BOA members and faculty suggested that the students would be even better prepared if they were provided more exposure to subjects of critical importance (e.g., Matlab and linear algebra) earlier in the program than is done at present.
- Two important areas for further improvement were programming skills and knowledge of energy-related technologies.

Student Outcomes – Expectation:
The expectation is that faculty will make changes to the course so as to improve the measures on the student outcomes. If the measure on any outcome falls to below 0.7, the Dept. Chair will get involved to analyze what changes are necessary in the program to attain that outcome. It was felt that the student outcomes are being currently met.

Survey responses were about 40.
Question was raised concerning how to stay in contact with alumni?
Jay will speak to Danny about lifetime @ee e-mail account
Jun Wang, Dean's Office, may be a contact for college alumni e-mail accounts
Question was raised regarding no engineering research responses on the survey?

Vote taken on the acceptance of the survey results: In-Favor, 10; Opposed, 0; Abstain, 0.

PART B: BOA MEETING MINUTES
This is a summary of the main feedback from each BOA meeting 2006 through 2012. The schedule of meetings during this time frame was

- May 12, 2006 – Onsite
- May 17, 2007 – Onsite
- May 15, 2008 – Onsite
- May 6, 2011 – Virtual
- May 10, 2012 – Onsite

For each of these meetings, there is a directory containing relevant files at

EE Server/EE_DEPARTMENT_Business/Board of Advisors/.

In the directory of each meeting, there is an agenda and a subdirectoy *FeedbackResponses* that contains the meeting minutes and any feedback received from the BOA in either written or email form.

Meeting 2006. The main topics of the BOA feedback were:

- Enhancing enrollment through promotion of Engineering
- Inviting recent alumni back to give talks
- Encourage joining toastmasters
- Suggested growth into systems engineering, energy, engineering management

Meeting 2007. ABET and the PEO's were discussed in depth. The main topics of the BOA feedback included:

- Discussion of the meaning and intent of the PEO's, especially around the idea and examples of evidence
- Request for a vision statement
- A vote in favor of the PEO statement
- A request for more time at the poster session

Meeting 2008. The program status and ABET were discussed. The main topics of the BOA feedback included:

- Request for a Charter or statement of BOA purpose
- Discussion of board membership: who else and what other industries.
- Several specific suggestions related to ABET documentation and feedback.
- Recommend partnering with one or more CC to allow fixing of mathematical deficiencies and maturing of students who are not ready to enter BCOE directly from High School
- Suggested growth into port and border security, nano materials and devices, energy and sustainability
- Suggestion to start an eta kappa nu chapter
- What can the BOA do to advance the goal of college ranking
    - Aim for small but superb. Ranking and enrollment will follow.
- Courses for non-EE majors:
    - Why things work?
    - How things work?
- Teach one Computer/language in depth and well. Do not teach many at a shallow level.

Meeting 2011. The program status and ABET were discussed. The meeting was held via teleconference using WebEx. Attending in person were R. Lake, P. Liang, A. Wang, S. Tan, A. Balandin, and A. Roy-Chowdhury and one member of the Board of Advisors (BOA), D. Rice. Present online were Paul Yu, J. Schulman, T. Kaboly, H. Chu, K. Krishasamy, B. Zhao, A. Agarwal, and J. Richardson.

Prior to the meeting the following link (www.ee.ucr.edu/~rlake/EE_BOA_materials.pdf) to an information packet and cover letter was sent to the BOA. Also, prior to the meeting, the board membership was increased and geographically diversified. Emphasis was placed on acquiring new members who had attained significant stature within their profession. The background of the membership was also diversified to include Prof. Paul Yu (former EE Dept. Chair and Vice Chancellor of Research, UCSD), Dr. Meyya Meyyapan (Chief Scientist for Exploration Technology, NASA AMES), and Dr. Joel

Schulman (Senior Scientist, The Aerospace Corp., provides project oversight on several national DARPA centers).

The main topics of the BOA feedback included:

- Request for future meetings to be on-site.
- Suggestion of more interdisciplinary efforts to magnify BCOE strengths.
- A well phrased question: given the present faculty strength at EE department, what would be natural extension areas that can utilize the present strength and require the least number of faculty growth to achieve the critical mass?

Meeting 2012. The program status, undergraduate and graduate curriculum, and ABET were discussed. The main topics of the BOA feedback included:

- For PEO's state "two or more items of evidence from two different categories." Otherwise they endorse. The like that the evidence is assessable.
- Raytheon rep. stated that the PEO's aligned well with Raytheon desires
- For outcomes, critical thinking and knowledge of resources for lifetime (Outcome i) learning are very important.
- The BOA was impressed with the EE efforts to fix retention, both by trying to improve our ability to select students likely to succeed and by trying to increase the success rates of those that we do receive.
- Suggest the EE consider on-line offerings of its new courses for non-majors
- Discussed which language was taught in CS courses. Stated that C was preferred for embedded applications, but liked that one language (C++) was taught in depth. Preferred that to several being taught at a shallow level.
- Endorsed efforts to better manage the EE175 course.
- Will think through and consider BOA bylaws
- Offered to:
    - Interact more frequently on an electronic basis
    - Judge senior design projects. One has done this for Cal Poly Pamona as part of their industrial action council. Each presentation was one hour with a 15 minute debrief.
    - Proofread the ABET document.
- Suggest focus on systems engineering
    - Successful COTS integration

External interfacing and communication

Appendix F: Alumni Survey

Analysis of Survey Questions 2009 & 2012

1. What year did you earn your bachelor's degree in Electrical Engineering?

(2009)

Answers- 19

Skipped- 5

Answer Options	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998
Year	0	1	4	0	1	1	1	1	1	2	2	5

(2012)

Answers- 11

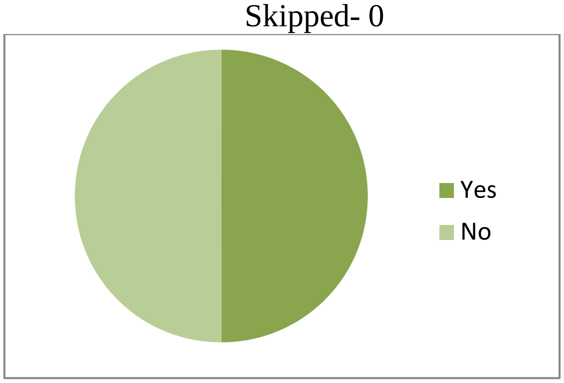
Skipped- 6

Answer Options	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998
Year	0	1	0	2	2	0	0	0	2	1	1	2

2. Have you pursued or completed any degrees beyond your bachelor's degree in engineering from UCR?

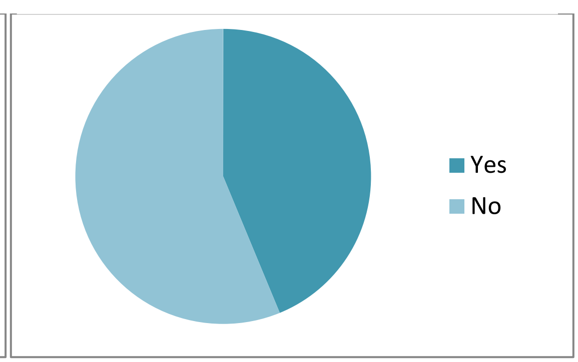
(2009)

Answers- 24: Yes- 12
No- 12
Skipped- 0



(2012)

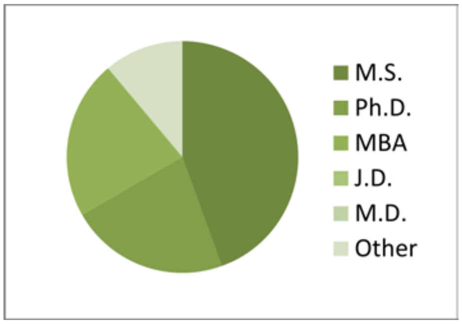
Answers-16: Yes: 7
No: 9
Skipped- 1



3. If you have completed another degree, please indicate all degrees completed.

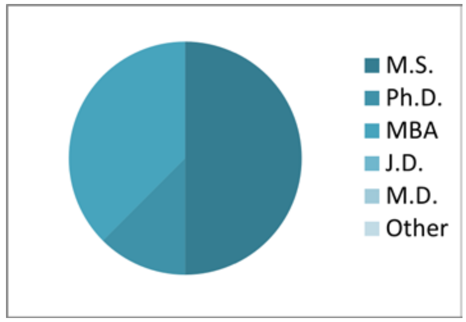
(2009)

Answers- 9: M.S.- 4
Ph.D.- 2
MBA 2
J.D. 0
M.D. 0
Other- 1
Skipped- 15



(2012)

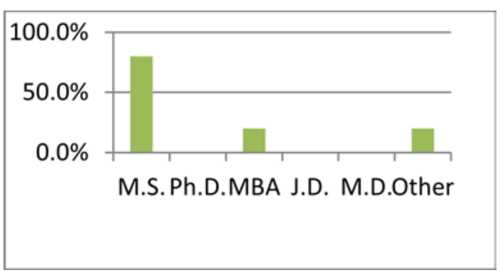
Answers- 8: M.S.: 4
Ph.D.: 1
MBA: 3
J.D. 0
M.D. 0
Other: 0
Skipped- 10



4. If you are pursuing another degree, please indicate the degree you are pursuing.

(2009)

Answers-5: M.S.- 4
Ph.D.- 0
MBA- 1
J.D.- 0
M.D.- 0
Other- 1
Skipped-19



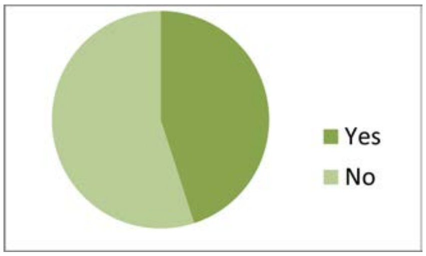
(2012)

Answers- 0
Skipped-17

5. Have you published articles and/or made presentations at conferences in your field?

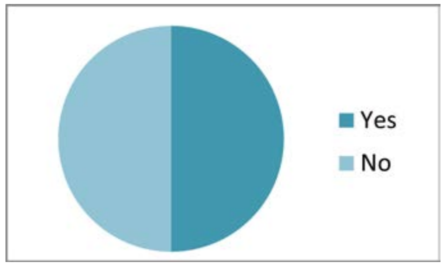
(2009)

Answers-20: Yes- 9
No- 11
Skipped-4



(2012)

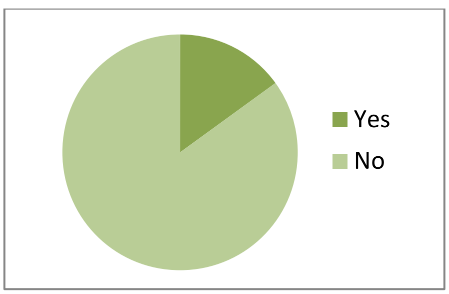
Answers-6: Yes: 8
No: 8
Skipped- 1



6. Have you been named on any patents or patent applications?

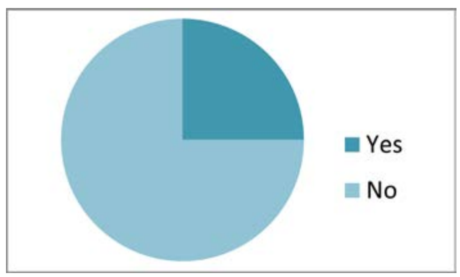
(2009)

Answers- 20: Yes- 3
No- 17
Skipped- 4



(2012)

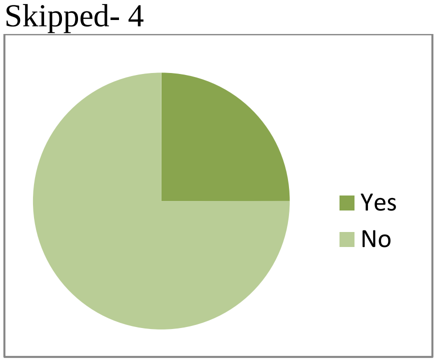
Answers- 16: Yes: 4
No: 12
If yes, how many?: 4
Skipped- 1



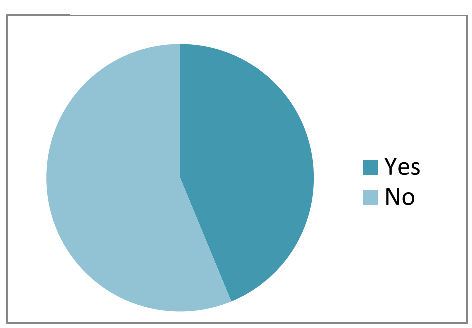
7. Have you received any awards for professional achievement?

(2009)

Answers- 20: Yes- 5
No- 15
Skipped- 4



1. (2012) Answers- 16: Yes: 7
No: 9
If yes, please describe: 4



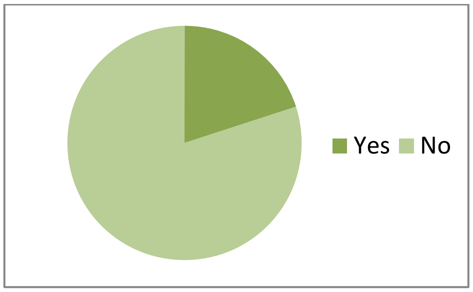
8. Have you engaged in any international research or collaborations (e.g. presented at international conferences, worked with international collaborators)?

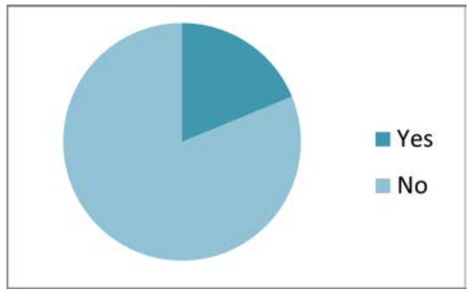
(2009)

Answers-20: Yes- 4
No- 16
Skipped-4

(2012)

Answers- 16: Yes: 3
No: 13
If yes, brief description of international activities: 1
Skipped- 1





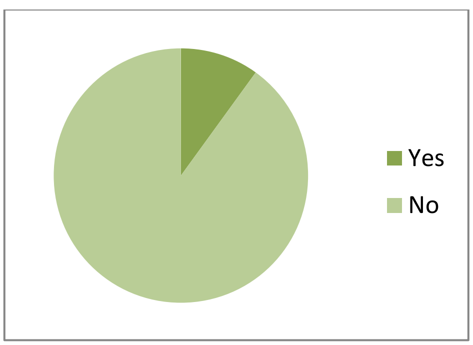
9. Have you been a program committee member or organizing committee member of a conference?

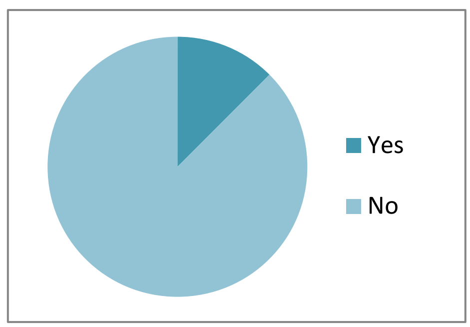
(2009)

Answers-20: Yes- 2
No- 18
Skipped-4

(2012)

Answers: 16 Yes: 2
No: 14
If yes, how many?: 2
Skipped: 1





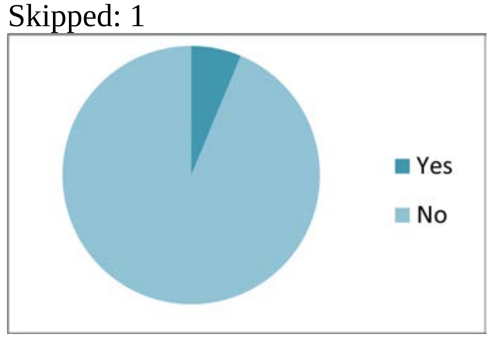
10. Have you been a reviewer for any journals?

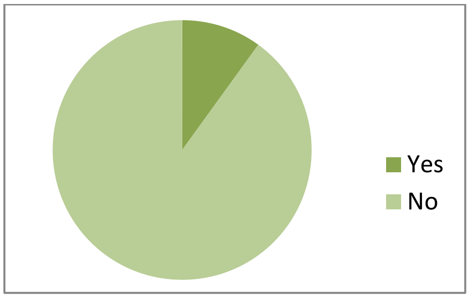
(2009)

Answers- 20: Yes- 2
No- 18
Skipped- 4

(2012)

Answers: 16 Yes: 1
No: 15
Skipped: 1



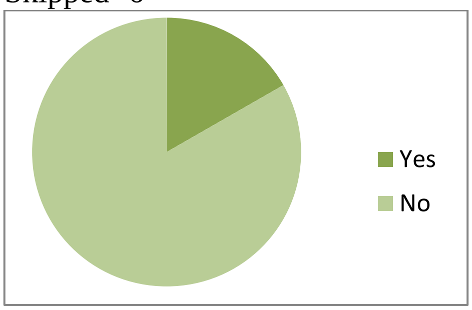


11. Have you engaged in other professional service such as scientific or technical review panels, serving as an expert witness, or consulting?

(2009)

Answers- 18: Yes- 3
No- 15

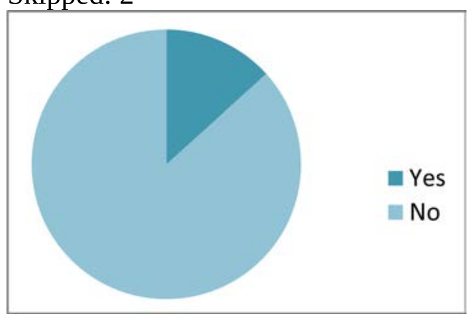
Skipped- 6



(2012)

Answers: 15 Yes: 2
No: 13

Skipped: 2



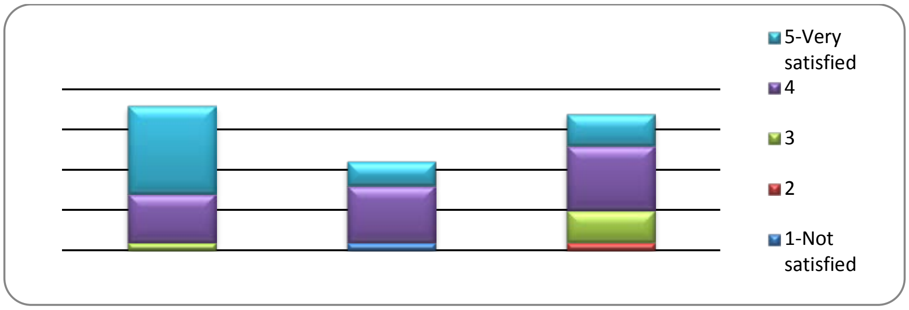
12. At this point of your career and education, what is the level of your satisfaction with your career choice and success in each of the following?

(2009)

Answers: 18

Answer Options	**5-Very satisfied**	**4**	**3**	**2**	**1-Not satisfied**	**Response Count**
The field you work in	11	6	1	0	0	18
The academic institution/lab you work in	3	7	0	0	1	11
Recognition of your work	4	8	4	1	0	17

Skipped- 6

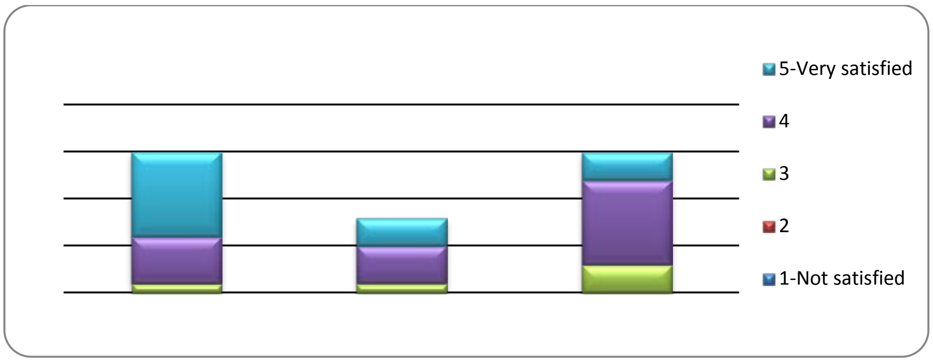

5-Very satisfied
4
3
2
1-Not satisfied

(2012)

Answers: 15

Answer Options	**5-Very satisfied**	**4**	**3**	**2**	**1-Not satisfied**	**Response Count**
The field you work in	9	5	1	0	0	15
The academic institution/lab you work in	3	4	1	0	0	8
Recognition of your work	3	9	3	0	0	15

Skipped: 2

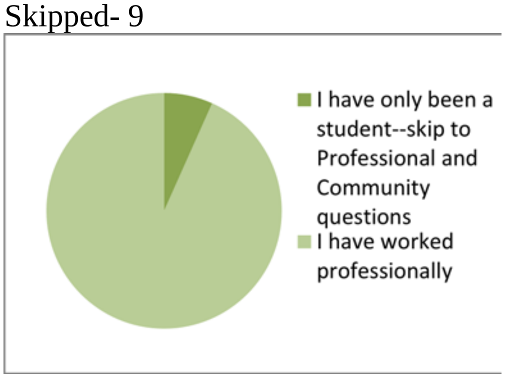


13. While pursuing an advanced degree, have you also been working professionally?

(2009)

Answers-15:
I have only been a student--skip to Professional and Community questions- 1
I have worked professionally- 14

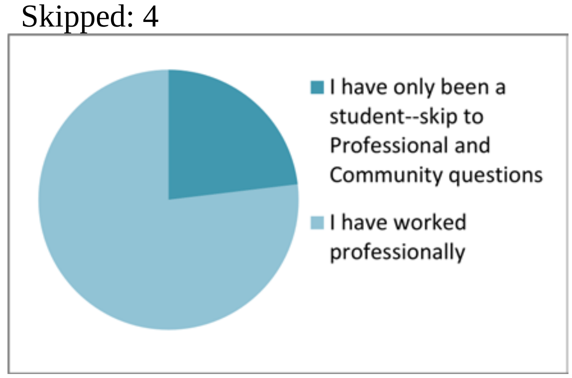
Skipped- 9



(2012)

Answers: 13
I have only been a student—skip to Professional and Community questions:
3
I have worked professionally: 1
0

Skipped: 4



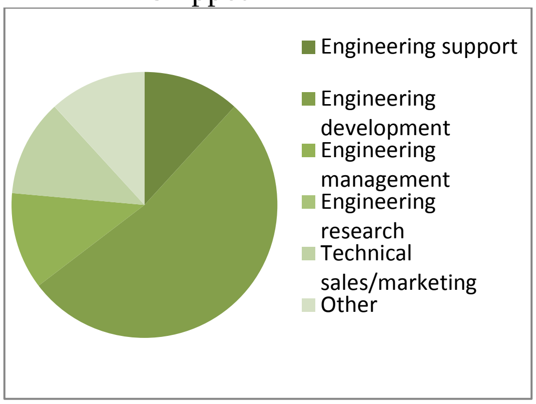
14. From the options below, please choose the one that best describes your current work.

(2009)

Answers- 17: Engineering support- 2

Engineering development-	9
Engineering management-	2
Engineering research-	0
Technical sales/marketing-	2
Other-	2
Other (please specify)-	4

Skipped-7

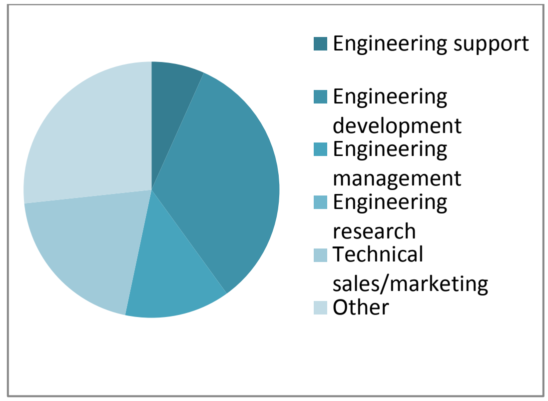


(2012)

Answers: 15

Engineering support:	1
Engineering development:	5
Engineering management:	2
Engineering research:	0
Technical sales/marketing:	3
Other:	4

Skipped: 2



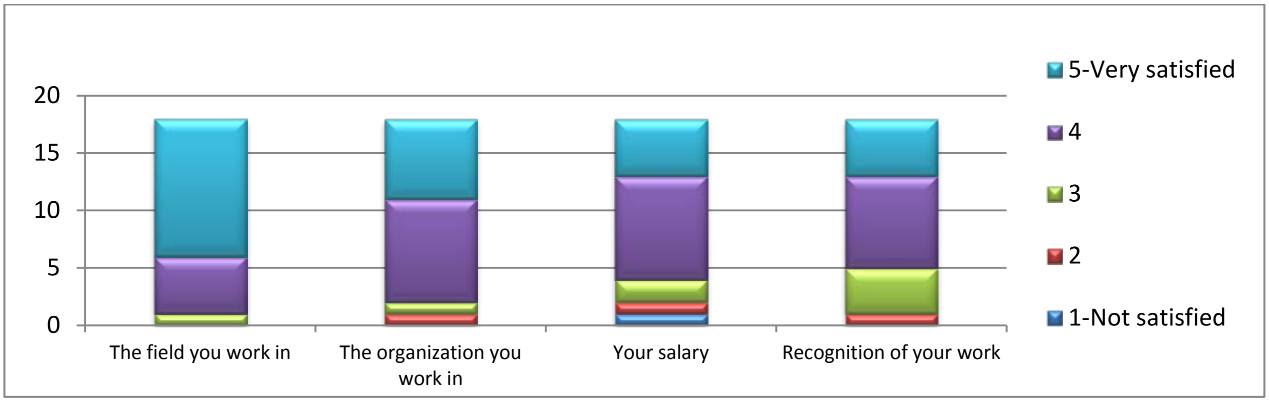
15. At this point of your career, what is the level of your satisfaction with your career choice and success in each of the following?

(2009)

Answers: 18

Answer Options	**5-Very satisfied**	**4**	**3**	**2**	**1-Not satisfied**	**Response Count**
The field you work in	12	5	1	0	0	18
The organization you work in	7	9	1	1	0	18
Your salary	5	9	2	1	1	18
Recognition of your work	5	8	4	1	0	18

Skipped: 6

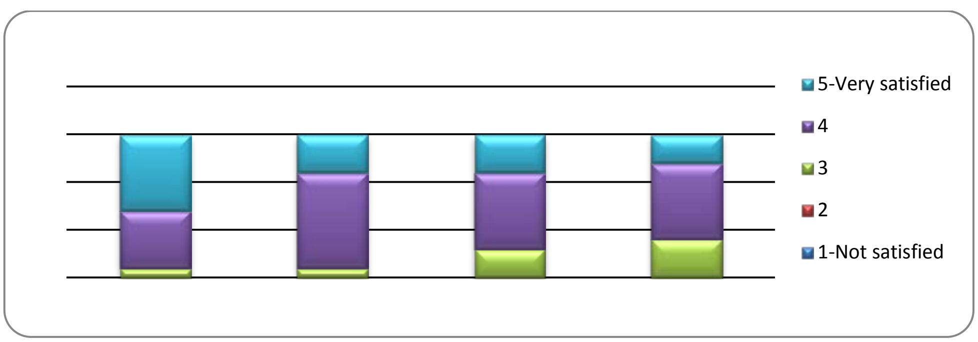


(2012)

Answers: 15

Answer Options	5-Very satisfied	4	3	2	1-Not satisfied	Response Count
The field you work in	8	6	1	0	0	15
The organization you work in	4	10	1	0	0	15
Your salary	4	8	3	0	0	15
Recognition of your work	3	8	4	0	0	15

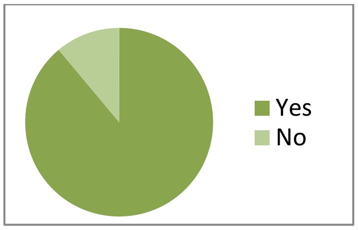
Skipped: 2



16. Have you had promotions and/or raises since beginning your professional career?

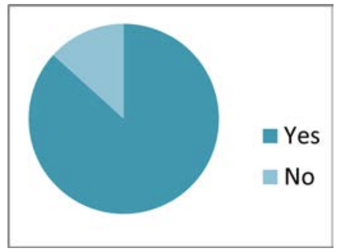
(2009)

Answers-18: Yes- 16
No- 2
Skipped-6



(2012)

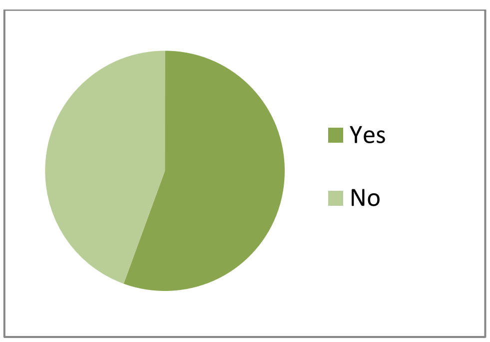
Answers:15 Yes: 13
No: 3
If yes, how many times: 11
Skipped: 2



17. Have you published articles or made presentations in your organization or in your profession?

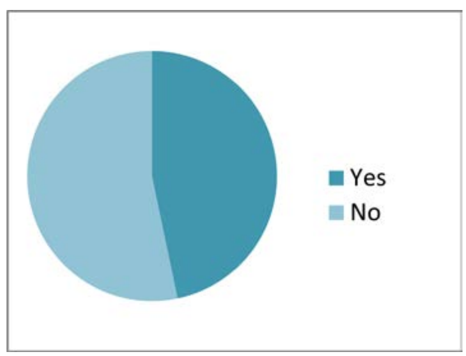
(2009)

Answers-18: Yes- 10
No- 8
Skipped-6



(2012)

Answers: 15
Yes: 7
No: 8
If yes, please describe: 4
Skipped: 2



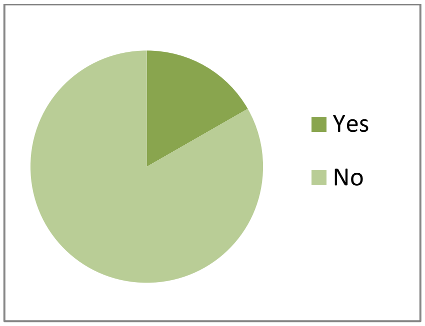
18. Have you engaged in international activities such as participation in international conferences, collaborative research, or employment abroad?

(2009)

Answers-18: Yes- 3

No- 15

Skipped- 6

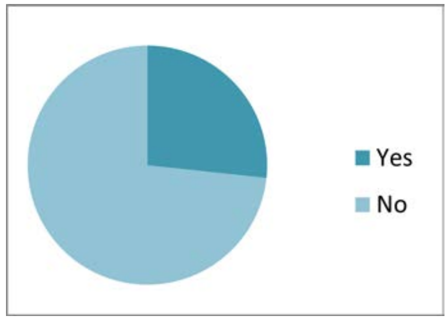


(2012)

Answers: 15 Yes: 4

No: 11

Skipped: 2



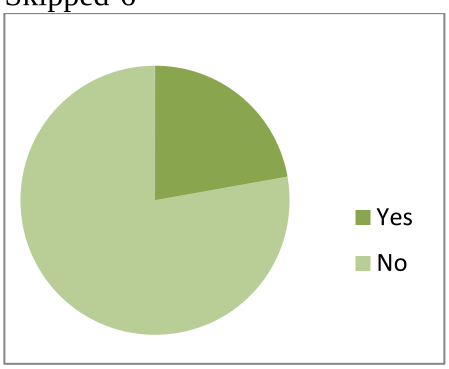
19. Have you made inventions and/or been listed on patents or patent applications?

(2009)

Answers- 18: Yes- 4

No- 14

Skipped-6

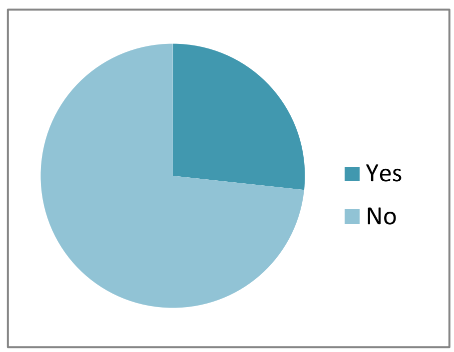


(2012)

Answers: 15 Yes: 4

No: 11

Skipped: 2

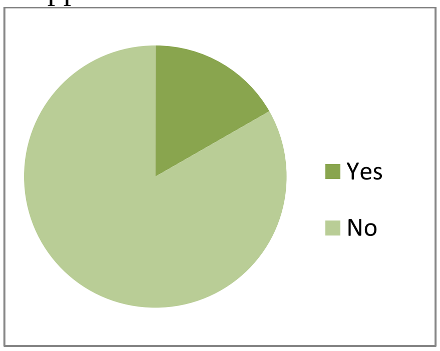


20. Have you been nominated for any professional or academic awards?

(2009)

Answers- 18: Yes- 3
No- 15

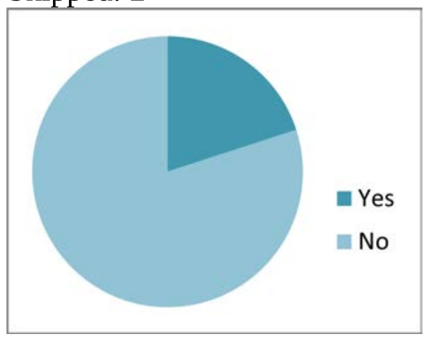
Skipped-6



(2012)

Answers: 15 Yes: 3
No: 12

Skipped: 2

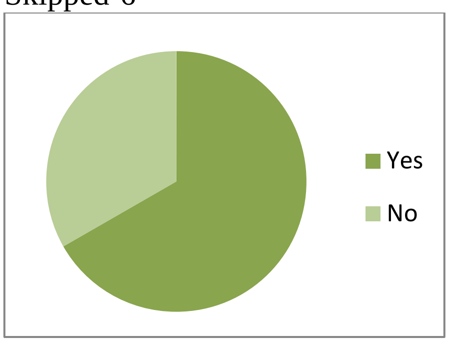


21. Have you mentored others, either inside or outside your organization?

(2009)

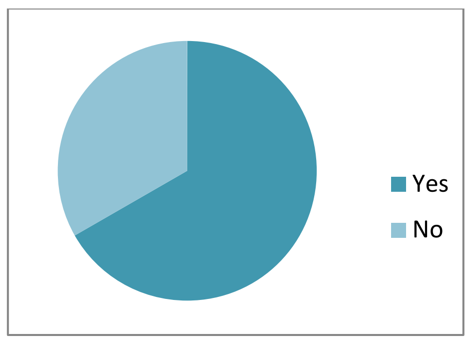
Answers-18: Yes- 12
No- 6

Skipped-6



(2012)

Answers: 15 Yes: 10
No: 5

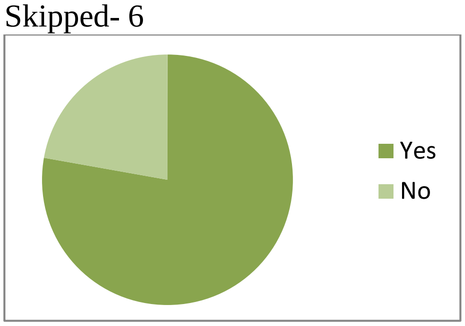


22. Have you led groups or teams on projects or new initiatives?

(2009)

Answers-18: Yes- 14
No- 4

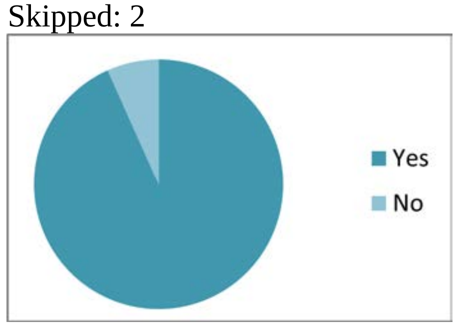
Skipped- 6



(2012)

Answers: 15 Yes: 14
No: 1

Skipped: 2

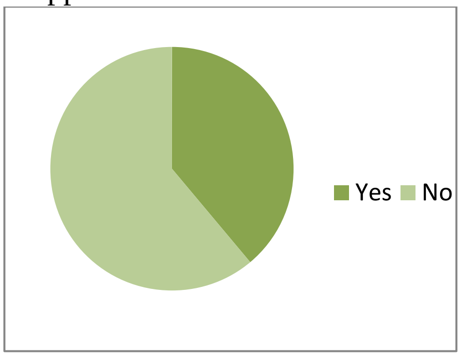


23. Have you engaged in any start-up businesses or been involved in any new ventures in your organization?

(2009)

Answers-18: Yes- 7
No- 11

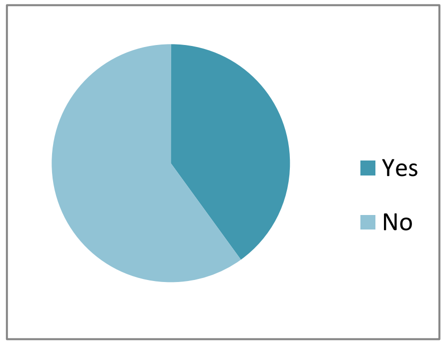
Skipped-6



(2012)

Answers: 15 Yes: 6
No: 9

Skipped: 2

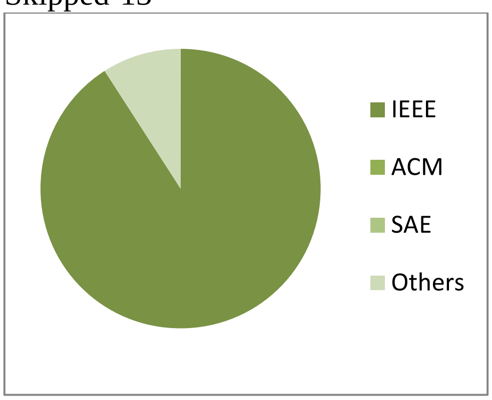


24. Are you a member of any professional societies?

(2009)

Answers-11: IEEE- 10
ACM- 0
SAE- 0
Other- 1

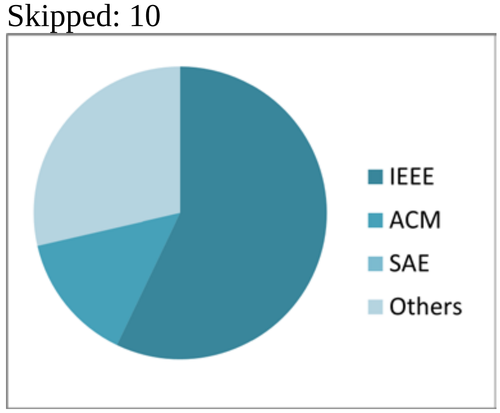
Skipped-13



(2012)

Answers: 7 IEEE: 4
ACM: 1
SAE: 0
Others: 2

Skipped: 10



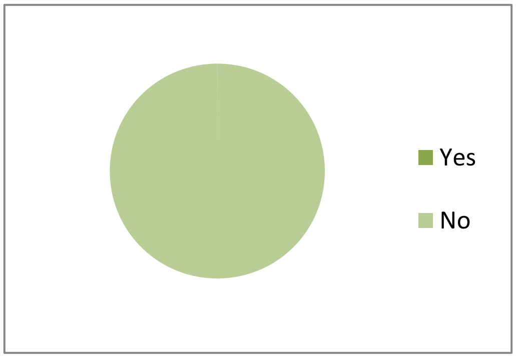
25. Have you obtained Professional Engineer certification?

(2009)

Answers-16: Yes- 0

No- 16

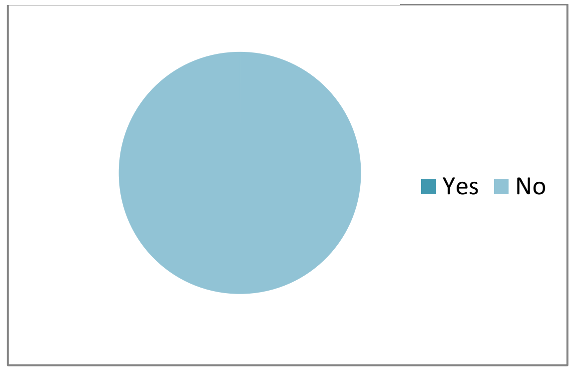
Skipped-8



(2012)

Answers: 15 Yes: 0

No: 15



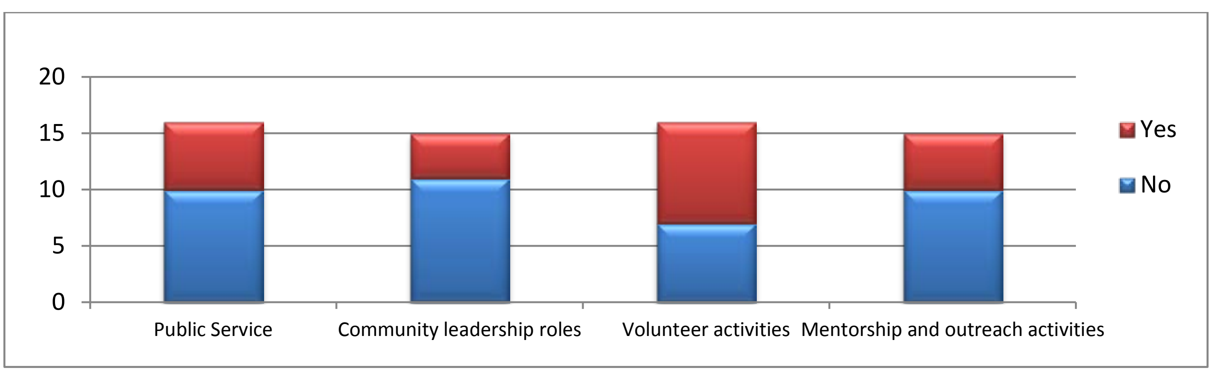
26. Have you been involved in any of the following activities?

(2009)

Answers-16:

Answer Options	Yes	No	Response Count
Public Service	6	10	16
Community leadership roles	4	11	15
Volunteer activities	9	7	16
Mentorship and outreach activities	5	10	15
Please describe your activities			5

Skipped-8

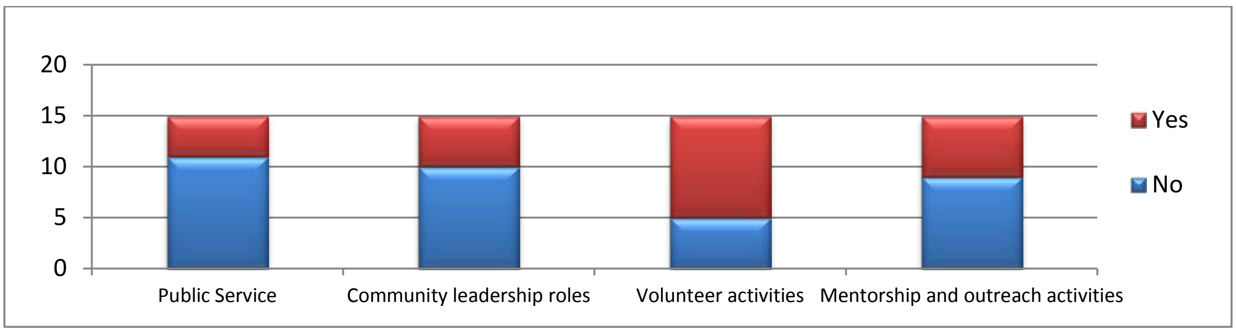


(2012)

Answers: 15

Answer Options	**Yes**	**No**	**Response Count**
Public Service	4	11	15
Community leadership roles	5	10	15
Volunteer activities	10	5	15
Mentorship and outreach activities	6	9	15
Please describe your activities			4

Skipped: 2

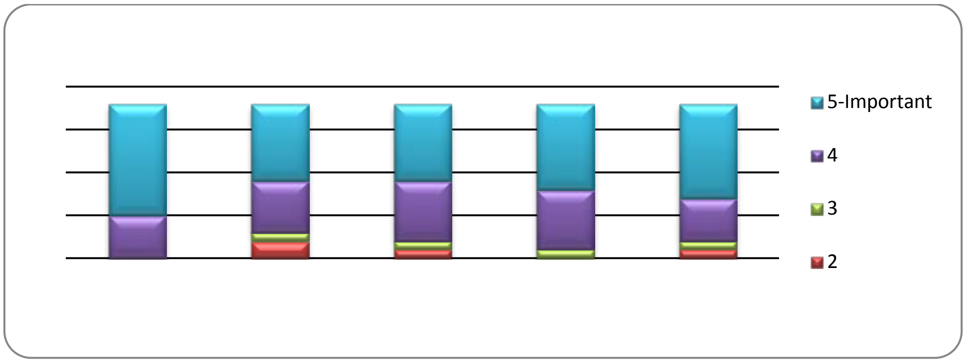


27. How would you rate the importance of the following items on your career path?
(2009)

Answers-18:

Answer Options	**5-Important**	**4**	**3**	**2**	**1-Unimportant**	**Response Count**
Basic math and science	13	5	0	0	0	18
Breadth requirements beyond math and science	9	6	1	2	0	18
Core curriculum in your major	9	7	1	1	0	18
Technical electives	10	7	1	0	0	18
Senior Design Project	11	5	1	1	0	18
Comments						2

Skipped-6

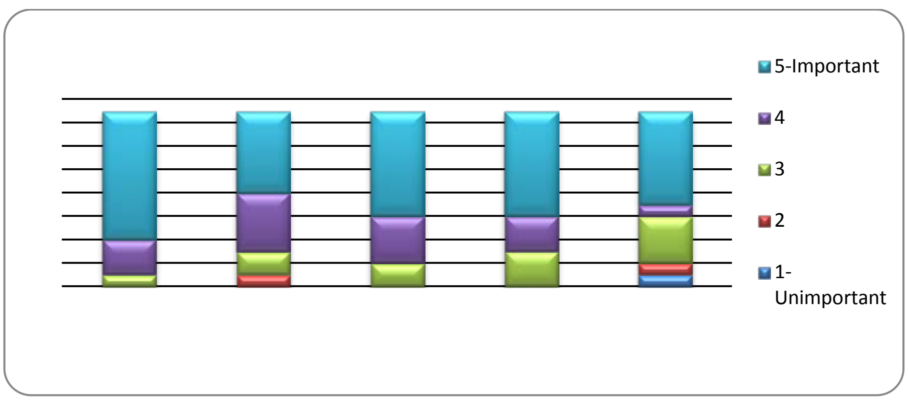


(2012)

Answers: 15

Answer Options	5-Important	4	3	2	1-Unimportant	Response Count
Basic math and science	11	3	1	0	0	15
Breadth requirements beyond math and science	7	5	2	1	0	15
Core curriculum in your major	9	4	2	0	0	15
Technical electives	9	3	3	0	0	15
Senior Design Project	8	1	4	1	1	15
Comments						2

Skipped: 2

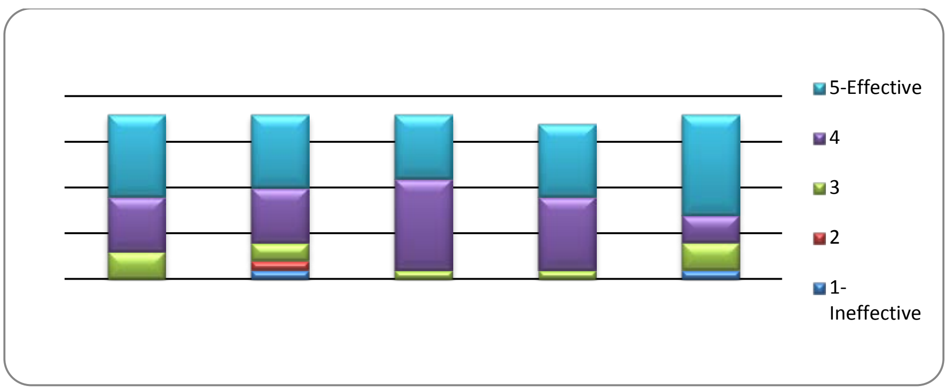


28. How would you rate UCR's effectiveness in preparing you in the following areas?
(2009)

Answers-18:

Skipped-6

Answer Options	5-Effective	4	3	2	1-Ineffective	Response Count
Basic math and science	9	6	3	0	0	18
Breadth requirements beyond math and science	8	6	2	1	1	18
Core curriculum in your major	7	10	1	0	0	18
Technical electives	8	8	1	0	0	17
Senior Design Project	11	3	3	0	1	18
Comments						1



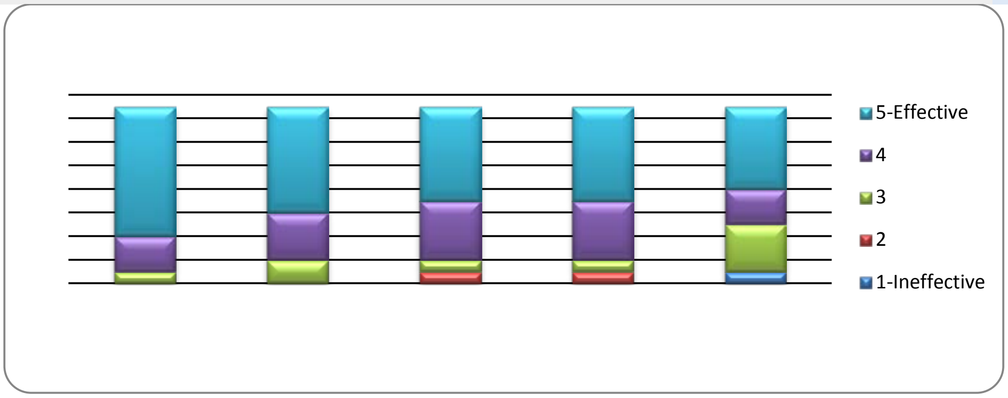
(2012)

Answers: 15

Skipped: 2

Answer Options	5-Effective	4	3	2	1-Ineffective	Response Count
Basic math and science	11	3	1	0	0	15
Breadth requirements beyond math and science	9	4	2	0	0	15
Core curriculum in your major	8	5	1	1	0	15
Technical electives	8	5	1	1	0	15

Senior Design Project	7	3	4	0	1	15
Comments						0



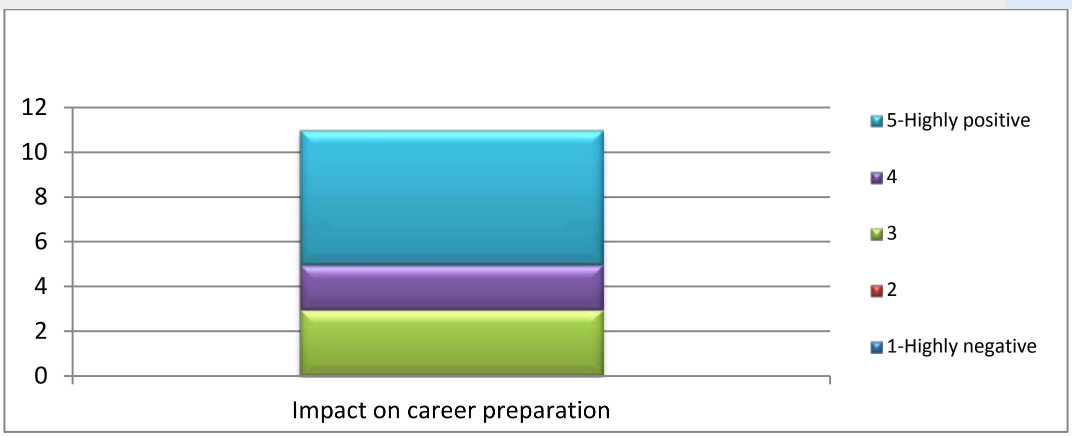
29. If you participated in research as an undergraduate, how much did that contribute to your preparation for further pursuits?

(2009)

Answers-11:

Skipped-13

Answer Options	5-Highly positive	4	3	2	1-Highly negative	Response Count
Impact on career preparation	6	2	3	0	0	11
Comments						3

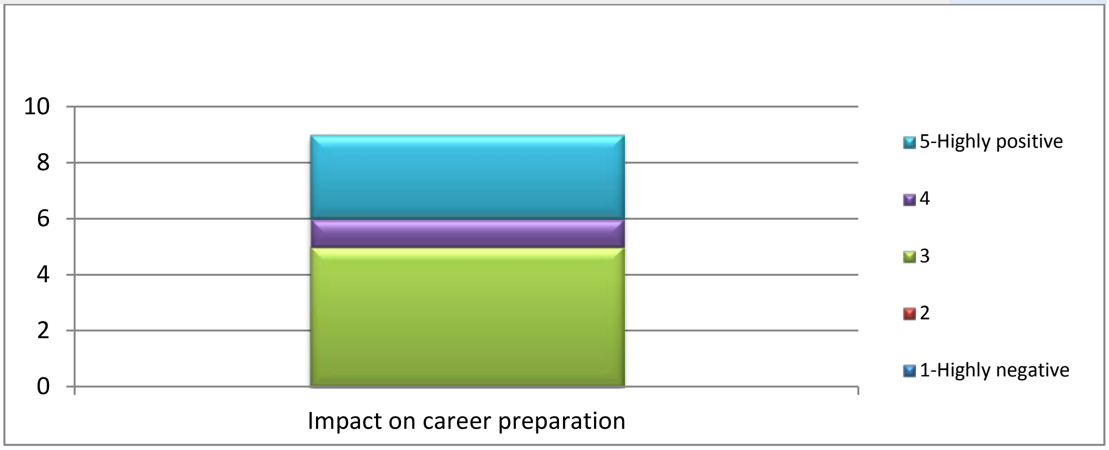


(2012)

Answers: 9

Skipped: 8

Answer Options	5-Highly positive	4	3	2	1-Highly negative	Response Count
Impact on career preparation	3	1	5	0	0	9
Comments						1



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

(2009)

Answer Options	Response Count
	11
answered question	**11**
skipped question	**13**

(2012)

Answer Options	Response Count
	7
answered question	**7**
skipped question	**10**

Signature Attesting to Compliance

By signing below, I attest to the following:

That the Department of Electrical Engineering has conducted an honest assessment of compliance and has provided a complete and accurate disclosure of timely information regarding compliance with ABET's *Criteria for Accrediting Engineering Programs* to include the General Criteria and any applicable Program Criteria, and the ABET *Accreditation Policy and Procedure Manual.*

Reza Abbaschian

Dean's Name (As indicated on the RFE)

June 26, 2012

Signature **Date**