ABET
Self-Study Report

for the

COMPUTER ENGINEERING

Program

at

King Fahd University of Petroleum & Minerals
DHAHRAN, SAUDI ARABIA

29 November 2009

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COMPUTER ENGINEERING PROGRAM

Bachelor of Science in Computer Engineering

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

BACKGROUND INFORMATION

0.1. Contact Information

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0.2. Program History

King Fahd University of Petroleum and Minerals (KFUPM) was established in September 1963. The first students were admitted a year later when 67 young men enrolled in what was then the College of Petroleum and Minerals (CPM). Since that time, the University enrollment has grown to more than 10000 students. The university has been all-male institution since that date.

Several significant events have marked the University's growth. In 1971, at the first graduation ceremony, four men received their baccalaureate degrees in engineering. In 1975, the College of Petroleum and Minerals became the University of Petroleum and Minerals, a change both in name and academic status. In 1986, the University was renamed: King Fahd University of Petroleum and Minerals.

The computer engineering program (COE) was established in 1986 at the College of Computer Sciences and Engineering (CCSE) at King Fahd University of Petroleum and Minerals (KFUPM). The degree title for those students who satisfactorily complete the program is the Bachelor of Science in Computer Engineering. This is the only Bachelor Degree offered by the program. More details about the program are available on the department website at: http://www.ccse.kfupm.edu.sa/coe/

Computer engineering is a discipline of interest and demand locally in Saudi Arabia, regionally in the Middle East and internationally worldwide. Currently, there is a critical shortage of computer professionals who can design and implement computer systems and networks. The Kingdom of Saudi Arabia has focused on computer technology and its utilization as one of the fundamental tools to modernize its industry to cope up with advances in modern technology. It is, therefore, mandatory to prepare highly qualified computer engineers who are capable of mastering the last advances in such a rapidly growing technology.

The Computer Engineering Department offers strong undergraduate educational program leading to a Bachelor of Science (BS) in Computer Engineering. It also have a well-established graduate programs leading to a Master of Science (MS) in Computer Engineering, and two programs joint with the Information & Computer

Science Department: Master of Science (MS) in Computer Networks, and Doctor of Philosophy (Ph.D.) in Computer Science and Engineering (CSE).

The Computer Engineering program at KFUPM provides a comprehensive coverage of a wide range of COE subjects and areas that are dynamically improving according to the need and applicability. Nowadays, COE concentrations cover:

- Computer Architecture & Digital Design
- Parallel and Distributed Systems
- Communications and Networks
- VLSI and Design Automation
- Computer Systems and Applications (Robotics, Security, Multimedia….etc)

Computer engineering tradition in education, research, and public service continues because of the commitment of the COE talented faculty, staff, and students and the endless support from KFUPM, the Saudi government, and the industry. Our relations with the industry include research collaborations, project contracts, short courses training, internships for students and faculty through summer training, and the Cooperative education program.

0.3. Options

The graduates from the program obtain a degree of Bachelor of Science in Computer Engineering. There is only one computer engineering program, and all students are full-time day and on-campus program students. The program provides the student two opportunities for industrial training; either through a two-month summer training program or through a 7-month COOP training program. The summer training program is equivalent to 0 credits while the COOP program is equivalent to 9 credits. The student has to submit a progress report on a regular basis during the training period and a final report should be submitted by the end of the training period. A committee will be formed by the department where the student will present and defend his work.

Moreover, the program gives the students the opportunity to pursue concentrations (during the last year of the program) in some subspecialties like Computer Communication and Networks, Computer Architecture, Digital System Design, and Computer Application**.**

0.4. Organizational Structure

The administration of the COE program is the responsibility of the chairman of the department. The administrative affairs are channeled to the upper administration, represented by his Excellency the Rector and the Vice Rector for Academic Affairs, the dean of the college of Computer Science and Engineering (CCSE), through the chairman of the COE department. The department chairman is responsible of the COE Faculty, COE students, COE Research Assistant and Graduate Assistants (RAs and

Gas), and COE Lab support staff. Figure 0.4-1 shows the organizational structure of the COE program.

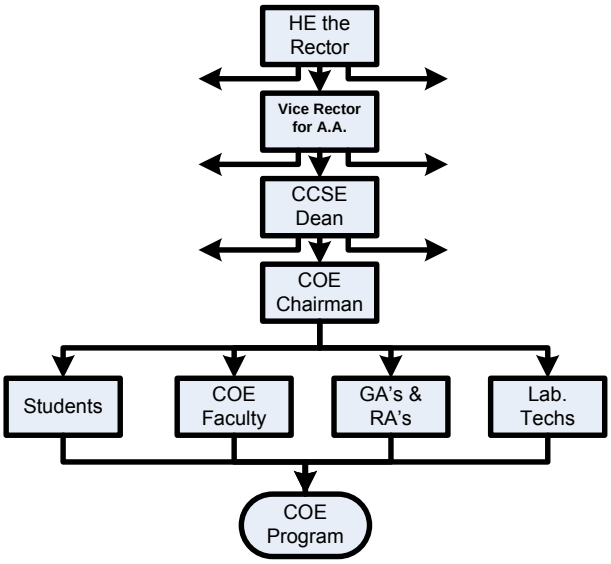


Figure 0.4-1. Overview of the COE program organizational structure

The chairman of the department is helped in administering the program by a number of standing departmental committees. Table 0.4-1 lists these committees/coordinators and their duties.

Table 0.4-1. Committees/coordinators, committee membership, and duties

	Standing Committee and membership	**Duties**
1	Graduate **Dr. Uthman Baroudi,** Dr. Alaaeddin Amin	• Updating the M.Sc. Program to reflect market demands and international standards. • Evaluation of new MS and Ph.D. applicants and reviewing graduate student's petitions. • Updating graduate Student Guide. • Monitoring graduate students' progress. • Preparing a list of addresses for COE or related departments in prestigious universities all over the world. • Preparing publicity material regarding Graduate Program in Computer Engineering, admission and fellowships in Computer Engineering.
2	Assessment **Dr. Marwan AbuAmara,** Dr. Mohammed Sqalli Dr. Tarek Sheltami	• Apply the COE assessment plan: coordinate the process of Rubrics assessment, data collection, data presentation, and the running all needed surveys. • Deliver the assessment data to the ABET committee.
3	Curriculum **Dr. Tarek Sheltami,** Dr. Radwan Abdel-Aal, Dr. Mohammed Elrabaa, Dr. Ashraf Mahmoud	• Evaluation of student petitions and dealing with Registrar memos. • Providing support on all curriculum related issues in the university. • Evaluation and review of course files. • Handling all curriculum related issues like double majoring, pre-requisites, graduation requirements, etc. • Review and recommendation on proposed new elective undergraduate courses in coordination with area coordinators.
4	ABET **Dr. Mayez Al-Mouhamed** Dr. Radwan Abdel-Aal Dr. Marwan Abu-Amara	• Prepare materials needed for ABET and other organization accreditation. Participate in IAC meeting and discussion. • Develop an Assessment plan • POs: Analyze assessment data and identify need for improvement • PEOs: analyze assessment data and carry out review of PEOs.
5	Lab **Dr. AbdulHafid Bouhraoua** Mr. Hazem Selmi Mr. Khalid J. Mallick	• Recommending the necessary enhancement of labs, for both teaching as well as research purposes. • Recommending the necessary equipment for various labs with the help of various labs' coordinators. • Reviewing and prioritizing lab equipment purchases. • Monitoring the departmental equipment inventory. • Planning lab development in terms of equipment, space, and manpower. • Preparing periodic status reports in respect of purchase requisitions.
6	Industrial Relation **Dr. Basem Almadani** Dr. Mohamed Mudawar Dr. Ashraf Mahmoud Dr. Wasim Raad	• Establishing links between the department and regional industry. • Publicizing the department programs to organizations and companies inside and outside the Kingdom. • Promoting department graduates to government and private organizations through all possible means. • Promoting department consultation services to government and private organizations. • Preparation of industrial brochures for the department. • Preparing some senior design projects for organizations and companies. • Preparing a list of possible speakers from the industries, and inviting them to visit the department.
7	Low Enrollment	• Look into the strategic planning for the Department. • Prepare publicity and presentations to prep year students

	Dr. Aiman El-Maleh	• Present the COE discipline to prep year students
8	Textbook and Course Assignment Liaison **Dr. Mohamed Mudawar**	• The acquisition and disposition of textbooks for courses in coordination with area coordinator. • Write to the publishers for getting complimentary copies of books for evaluation for the undergraduate/graduate courses. • Write to the publishers for getting complimentary copies of books for evaluation for the undergraduate/graduate courses. • Review and recommendation of textbooks for proposed new elective undergraduate/graduate courses and any changes to textbooks in coordination with area coordinators. • Prepare Book PRs for every year's needs (two regular semesters & one summer session) for COE undergraduate & graduate courses, with the coordination of the Chairmen of COE Undergraduate and Graduate Committees. • Any communication with Bookstore and Library regarding textbooks.

The Industrial Advisory Board of the department is formed under the name of Industry Advisory Committee (IAC). It is chaired by the department chairman and six members from the industry and four COE faculty members. Table 0.4-2 lists the IAC members.

Table 0.4-2. Industry Advisory Committee

	Industry Advisory Committee	Role	Title and Affiliation
1	Dr. Adnan Gutub	Chairman	Associate Professor, Chairman of the COE Department, KFUPM, Dhahran 31261, KSA
2	Dr. Khalid Al-Biyari	Member	Senior Vice President, Advanced Electronic Company, PO Box # 90916, Riyadh 11623, KSA.
3	Mr. Ali A. Al-Masari,	Member	Superintendent, Communications Operations Department Saudi Aramco, P.O. Box. 1297, Dhahran 31311, KSA
4	Mr. Masud Eid Al-Amiri	Member	General Manager, Information Technology Services SABIC, Riyadh 11422, Saudi Arabia.
5	Mr. Ahmad Ashadawi,	Member	President, Al-Falak Electronic Equipment & - Supplies Co, Al-Khobar, KSA.
6	Mr. Alaa Abunijem,	Member	MS, PMP, Energy Team lead and Strategic Relations Manager, Middle East, Turkey and Africa, Intel Corporation, PO Box 7247, Riyadh 11462, KSA
7	Mr. Aiman H Mufti,	Member	Supervisor, Technical Knowledge Sharing Unit, Engineering Knowledge & Resources Division, Saudi Aramco, Dhahran, KSA.
8	Dr. Dr. Mayez Al-Mouhamed	Member	Professor, Computer Engineering Department KFUPM, Box No. 787, Dhahran 31261, KSA.
9	Dr. Aiman El-Maleh,	Member	Associate Professor, Computer Engineering Department KFUPM, Box No.1063 , Dhahran 31261, KSA.
10	Dr. Ashraf Mahmoud	Member	Assistant Professor, Computer Engineering Department KFUPM, Box No. 1724, Dhahran 31261, KSA.
11	Dr. Basem Almadani	Member	Assistant Professor, Computer Engineering Department

			KFUPM, Box No .1195, Dhahran 31261, KSA.

The COE ABET Committee is responsible for the supervision of the direct and indirect assessment processes, carrying out continuous improvement, and preparation of the ABET Self-Study Report. It consists of the following members:

1. **Dr. Mayez Al-Mouhamed**, Chairman
2. **Dr. Radwan Abdel-Aal**, Member
3. **Dr. Marwan Abu-Amara**, Member

0.5. Program Delivery Modes

There is only one mode of delivery, which is a "Day Program". The students are full time students. They attend full day program in face-to-face mode. The academic year is composed of two 15-week regular semesters in the Fall and Spring semesters and an 8-week condensed Summer. Each graduating student has to successfully complete 131 credits. Each semester credit is one 50-minute lecture a week or 3 hours of lab a week.

The university has expanded in the past ten years in the development of on-line courses. These are used as supplementary material for the class room instruction.

0.6. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions taken to Address them

The COE program has undergone several cycles of curriculum and assessment-improvement cycles. Indeed, the assessment methods and procedures themselves have gone through several evolutions including the alignment to ABET EC 2K.

In 2001, the broad objectives of the undergraduate program in Computer Engineering were to instill in its graduates a solid foundation of mathematical, scientific, and engineering knowledge in addition to developing the intellectual skills essential for prosperity and success in their careers. These lead to define a set of three broad program educational objectives and a set of seven program outcomes.

A corrective cycle (1999-2001) was carried out in response to the comments/assessment of the ABET team who visited the department. Although, the program was fully accredited, some concerns were raised by the ABET team. These ABET concerns (C) and the corresponding corrective actions (A) that were taken by the faculty are as follows:

a. C-1: There was no enough flexibility in the program. Students could not select general electives from arts or other disciplines (other than their major).

   A-1: This problem was compounded by the fact that KFUPM is a technical institution; it had no arts college. The issue was taken with the

university administration (since it was a common problem for all programs) and many electives were created under the 'General Studies' division. Students now have access to, a relatively, wide selection of general interest courses such as Psychology, Industrial Sociology and Production, International Relations, Man and environment in addition to many courses on Arabic literature and Islamic theology. Students also have access to courses in Architecture, Marketing, Accounting, Finance, and Business Administration. The COE program was revised to allow students to take 3 general electives to take advantage of the presence of these courses.

b. C-2: There was a need to create a process for validating and evaluating the attainment of the established program objectives and outcomes.

   A-2: The process has been created as explained in this report under criterion C2, C3, and C4.

c. C-3: Projects taken by students in COE485 (Senior Design Project Course) and in the COOP course (COE351) were mainly limited to analysis and hence did not provide any design experience for the students. There was a need to strengthen the program's design component through greater emphasis on economic factors, safety, reliability, aesthetic, ethics, and social impact.

   A-3: First, the department had established two Ad-hoc committees (one for COE351 and another for COE485) to look into this issue. These courses were modified accordingly to improve the engineering design component. Some guidelines were developed. Also, in T081 a continuous improvement action for program outcome (c) "an ability to design a system, component, or process to meet desired needs" was conducted. The above action resulted in a noticeable improvement in the corresponding rubric (See Criterion 3 and 4 for more details). Second, many new electives were created within the program to expose the students to emerging technologies and contemporary issues related to the disciplines of the COE Program (Networks and Embedded Systems). Third, the university has created a course on Ethics (IAS 211/212 including work ethics) which also addresses the contemporary issues related to technology the large. This course was made compulsory upon all KFUPM students.

The Program Educational Objectives (PEOs) have gone through a new phase of revision in 2008. The feedback of the constituents (Faculty and Industrial Advisory Board) was taken into consideration. The revised set of objectives in the final form were discussed and approved by the department and college councils. The new COE educational objectives were published on the department Web site and can be accessed at: http://www.ccse.kfupm.edu.sa/coe/abet/objectives.html

In its extension of substantial equivalency recognition, dated October 8, 2008, the chair of the International Activities Council, ABET, Inc. provided the following concerns with the corresponding departmental actions:

1. C1: It is suggested that surveys of supervisors of Cooperative education and intern students is probably better suited to securing indirect information with respect to fulfillment of outcomes, which may, of course, benefit assessment or suggest changes in Program Educational Objectives.

   A-1: A new survey was designed for the COOP supervisors. The survey addresses the level of achievement of the program outcomes and provides some space for commenting on the PEOs. Note that we have only a few students selecting the COOP option (only 2 in T082). For this we have very few COOP Supervisor Survey filled.

2. C-2: The Self-Study needs to better disclose how actual learning by students is judged and how the ratings of that learning using direct measures – student-by-student in a set of covering course for a Program Outcomes – are assembled into a finding of level of achievement of the Program Outcome.

   A2: The Self-Study Report (Section 4 on "Continuous Improvement") has been revised. It describes the rating approach used in some courses which are used to carry out the rubrics assessment. The reported data involves the student-by-student figures as well as overall average figure for each program outcomes. This data is presented as part of the display material. The level of achievement of each outcome results from combining (average score) the achievement of the same outcome from a few different courses whose activities reasonably involve the same outcome (see Table 3.6-13).

3. C-3: Overall the program Outcomes and associated direct measures based assessment process is reasonable, but requires some refining. Though some redundancy through indirect corroborative measures is generally deemed essential, the degree of indirect, corroborative measures for the Program Outcomes appears excessive and the effort required may not be sustained.

   A-3: The Assessment methods for both PEOs and PO have been revised. The PEOs assessment is now based on surveying the Employer and Alumni. The needed refining is now manifested in the Assessment Plan which is described in Criterion 3. The new assessment plan is based on a three years cycle: (1) two years are allocated to carry out continuous improvement (of some outcomes), and (2) collecting the assessment data in the third year. The COE ABET committee and the COE faculty analyze the surveyed data and consult with Advisory Committee. The POs assessment is now based on Direct and indirect assessment tools. Direct assessment includes: (1) the rubrics assessment, (2) average student grades in some supporting courses (MATH, PHYS, ENGL, IAS, STAT), and (3) Exit Exam. Indirect assessment tools include exit survey and COOP supervisor survey.

4. C-4: Every effort should be made to remove inconsequential but irritating errors in the Self-Study.

A-4: A lots of effort has been made to re-organize the self-study and provide proper cross referencing of tables, figures, and appendices.

5. C-5: It is noted that physical education is not usually included in the classification of general education. The remaining courses in the listed general education requirements, including those available as electives, are of limited scope across what are usually though of as humanities and those sciences consistent with an engineering education. However, though limited in scope, those courses available to students appear consistent with the cultural context of the institution and the countries in which they are most likely to enter the practice of engineering. Furthermore, they will undoubtedly help the students acquires the "Soft skills" related Program Outcomes.

   A-5: The physical education courses are now removed from the general education courses. The University is currently developing a separate general education program with more coverage of humanities and engineering education.

6. C-6: With respect to the major design experience, the Program needs to more clearly illustrate that is a culminating experience. This could be accomplished by showing a map of the courses displaying their sequence in conformance with semester, pre-requisite, and co-requisite sequencing, overlaid by progressive design sequences leading to the major design experience.

   A-6: The courses COE 400 "embedded Systems" and COE 485 "Senior Design Project" represents a learning platform where knowledge and skills acquired across the COE program are culminating in a major design experience. A flow-chart has been designed to show the knowledge and skills learned from various COE course broken down into semesters and showing pre-requisite and co-requite edges.

7. C-7: As noted for Criterion 7 above, financial support for laboratory resources has been declining somewhat over the past several years. This may be entirely reasonable, but such reasons should be explained in the self-Study.

   A-7: Fluctuation in the financial support is due to on many factors like: the need to expand the current educational and research facilities, faculty need for all kind of project, and the availability of consumable components.

CRITERION 1. STUDENTS

1.1. Student Admissions

An applicant for admission to an undergraduate program at King Fahd University of Petroleum & Minerals (KFUPM) must satisfy the following minimum requirements:

1. He should have a Saudi secondary school certificate, or its equivalent, and majored in natural or technological sciences.
2. He is required to take entrance exam which consists of an aptitude test, and a subject test administered by the National Assessment Center for Higher Education in a large number of centers across the Kingdom.
   a) The aptitude test has two components: Mathematics and Linguistics. The test is aimed at determining the general capabilities of students in the two areas mentioned above.
   b) The subject test is an objective type multiple-choice test given in five subjects, i.e., Mathematics, Physics, Chemistry, Biology and English. The objective of this examination is to evaluate the student's knowledge and ability in English and Science.
3. The university assigns certain weight to the three components, i.e., high school grade, and the aptitude test and subject test scores. A cut-off point is decided for the weighted average of the applicant's grades in the three components and the eligible students are pronounced successful for admission.
4. The number of students accepted is limited to the number of seats available as decided by the University Council based on the capacity of resources at the University. Table 1.1-1 shows history of admissions standards to KFUPM baccalaureate programs for the past five years.
5. The applicant must submit the required documents with the University within a specified period.
6. An applicant who has graduated from a secondary school system outside the Kingdom of Saudi Arabia must have completed twelve years of combined primary and secondary school studies from a recognized school. He is also required to provide an equivalency certificate from the Saudi Ministry of Education

Admission to KFUPM is highly competitive. As explained above, applicants are granted admission in accordance with an overall evaluation on the basis of their academic record plus the entrance examinations, but only to the extent permitted by the maximum number of new admissions established for each academic year. Six categories of admission are recognized, each is associated with the academic level to which the students are admitted.

1. ***Admission to the Preparatory Year Program:*** All newly admitted students spend their first academic year in the Preparatory Year Program. The major objectives of this program are: (a) to improve the students' English proficiency and thus enable them to begin the first year of undergraduate studies in English, which is the principal language of instruction; (b) to review and reinforce the students' knowledge of mathematical and analytical techniques with English as the language of instruction; (c) to introduce the students to new subject areas and techniques such as physical science and computer science to improve their manual dexterity and develop their practical skills; (d) to develop university study skills needed by the students; (e) to expose the students to the various academic specialties available in the University leading to professional careers in engineering, science, computing, architecture, and management; (f) to improve the students' physical well-being through Physical Education courses, and (g) to familiarize the students with the rigors of the demanding academic work of a technical university, including all requisite study skills.

   Students are placed at the appropriate levels of the program as they advance through the first year's courses and they are required to pass each level of courses in the curriculum. These levels are:

2. ***Partial Promotion to Freshman Level:*** Students whose performance in the entrance examination is outstanding are given a chance to take the University promotion examination in English and Mathematics. Those who pass the test(s) in one or both the subjects are partially promoted to freshman level and are allowed to take college level courses along with the remaining Prep-Year courses.

3. ***Promotion to Freshman Level:*** Students have to score a minimum grade of "C" in all Prep-Year English and Math courses, and a minimum of "D" in all remaining courses to be eligible for promotion to freshman level.

4. No special policy exists for admission into engineering courses. However, once a student is admitted to the freshman year, he can choose any of the fields of study he wishes, including those in engineering which are open to him.

5. A student seeking transfer to an engineering department from a non-engineering department at KFUPM must have the approval of both departments. All courses required by the department to which the student is transferring and which the student has successfully passed are transferable.

6. Admission policy of transfer students from other university will be described below in section D (Transfer Students and Transfer Courses).

Table 1.1-1. History of Admissions Standards for Past Five Years

Academic Year	Percentile Rank in High School	Aptitude test Ram1	Subject test Ram2	Composite score		Number of New Students Enrolled	
	AVG.	AVG.	AVG.	MIN.	AVG.	Prep Year (for all programs)	Freshmen (COE)
2008-2009	96.79	85.29	77.52	79	83.71	2310	8 (T081)
2007-2008	96.03	85.48	83.12	85	88.34	1564	62
2006-2007	94.86	82.95	79.58	82	85.96	1996	49
2005-2006	95.56	83.46	73.78	80	84.31	1186	69
2004-2005	94.44	80.50	65.79	78	80.25	1225	73

1.2. Evaluating Student Performance

The student performance is determined though the process of assignment of academic status. A student's academic status will be determined at the end of each semester and will appear on the transcript that shows his achievements throughout his undergraduate study. However, the summer session has no effect on academic status. A student's academic status may be one of the following:

1. Good Standing: This status is assigned to all students at the beginning of their course of study. Students are expected to maintain this standing till their graduation. This involves a minimum GPA of 2.00 out of 4.00 in the student's cumulative and semester GPA.
2. Academic Warning: A student will be given this status after the final grades have been processed at the end of each regular semester if: (a) his cumulative GPA is less than 2.00 but more than 1.00, out of 4.00; (b) his semester GPA is less than 2.00 out of 4.00.
3. Academic Probation: A student is given this status after the final grades have been processed at the end of a regular semester, if his cumulative GPA is less than 1.00 out of 4.00.
4. Discontinued: A student is discontinued for at least one regular semester in either of the following two cases if: (a) he was previously on academic warning or probation in a regular semester and in the next term achieved a semester GPA of less than 1.50 out of 4.00; (b) the student receives three consecutive academic warnings. The Rector of the University may however give the student an opportunity to continue his studies following the recommendation of the relevant college council.

The ending of Academic Warning or Probation Status is carried out according to the following conditions. The status of academic warning can be revoked after the lapse of one regular semester from the date of the warning if the student achieves a semester semester and cumulative GPA of 2.00 or above at the end of this semester. A student

who has been discontinued may apply for readmission within a period not less than one month from the beginning of the next semester. The Admission and Academic Standing Committee, in coordination with the student's major college, consider applications for readmission of the student at the end of his discontinuation period. This period is not included in the period required to finish a degree.

The Registrar office at KFUPM prepares a document called degree audit for every student. The degree audit is a summary of the individual student's graduation status. It contains a list of all courses that must be completed by the student to meet the graduation requirements of his chosen major. The student indicates which of those courses have actually been completed, which are left to be completed, and an estimated graduation time, given normal semester course loads. In summary, the Academic Department Head and the Registrar are jointly responsible to ensure that all students meet the program requirements.

1.3. Advising Students

Each student is assigned a faculty advisor (FA) at the time of his initial enrollment. The FA is a faculty member in the academic department or the college in which the student is enrolled. The number of students assigned for each FA does not exceed 20 to ensure the effectiveness of the advising system. The FA is available to solve any problem that might arise during the student program. The advisor of the preparatory year students is the Director of the Preparatory Year Program or anyone he authorizes to act on his behalf. The University considers student advising by faculty as an important teaching-related activity. The FA is expected to advise students in planning their academic programs during early registration, registration and throughout the academic year whenever a student seeks his advisor's input in academic matters. The FA has four major roles:

1. Advise and help students in early registration and registration formalities,

2. Provide guidance in dropping and adding courses and in improving academic performance,

3. Ensure that the students understand the academic regulations and follow their academic programs in a sequential order, and

4. Follow-up the students' academic progress, especially those who are not in good academic standing.

The students have access to an electronic copy of the undergraduate bulletin which describes elaborately the program requirements:
http://www.kfupm.edu.sa/kfupm/admissions/undergrad_bulletin.pdf

Also, a hard copy of the bulletin is available at the University Bookstore.

At the beginning of the early registration and registration period, the Deanship of Admissions & Registration supplies the list of advisees assigned and the most

recent transcripts of student's academic records and their degree audit (Analysis of Degree Programs) to each advisor for his use. A student selects his courses in a semester in consultation with the advisor, who ensures that the courses are chosen appropriately in accordance with the degree plans, satisfying the prerequisites and other specific requirements of the courses and complying with the minimum and maximum course loads allowed for early registration and registration of courses by students. An advisor must be closely familiar with the regulations of the University, which are specified by the Deanship of Admissions & Registration.

A mid-semester week is designated as the early registration week of the next semester. On early registration, a student can make changes to his course selection with the consultation and approval of the advisor. Students are allowed to register early after they have consulted with their academic advisors. It is the duty of the academic advisor to assist his advisees in interpreting and understanding the academic regulations, in choosing the required and the elective courses in the desired sequence, in verifying the degree requirements for graduation, and in improving academic performance. The advisor can also review these courses on-line to monitor the student choices. The university's automated registration system checks for pre- and co-requisites and does not allow students to enroll in a course when they have not successfully completed. The automated system allows a student to register based on courses currently registered (not completed yet). The system will automatically drop the courses if the student did not successfully complete the pre-requisites.

The early registration and confirmation of the registration are performed online using the Deanship of Admission and Registration (DAR) website is through URL:

http://regweb.kfupm.edu.sa

The use of on-line registration in the last two years has produced effective results in reducing the time and effort for the registration process. All the information needed to guide and help the students to conduct the registration process are provided in details in the above web site. Moreover, the registration instructions for advisors are provided. In addition to the courses schedule, timing, and locations of the registration, the web-page includes registration procedure, steps for adding and dropping courses, and section changing.

The minimum course load is 12 credit hours during a regular semester. This condition is relaxed in the last semester before graduation. The maximum course load is then 19 credit hours.

However, for students who are not on good status, the maximum course load is 13 credit hours. Also, preparatory year students who are promoted to freshman level with a cumulative GPA less than 2.00 should not exceed 13 credit hours. Students having early-registered in more than 13 credit hours should drop course(s) to bring the course load within 13 credit hours. Otherwise, their course(s) will be dropped after the last day of adding.

For students on good academic standing status, the total number of credit hours registered by a student in any two consecutive semesters should be at least 28. A student is permitted to register for 21 credit hours with the approval of the department chairman if the student has maintained a minimum cumulative GPA of

3.00 out of 4.00 in all works undertaken during the preceding terms in which he earned his last 28 credit hours.

The registrar frequently updates the bylaws and procedures concerning this matter.

The university has established a special office called "Counseling and Advising Center (CAAC)" (http://www.kfupm.edu.sa/caac/) under the Deanship' of Student Affairs for this purpose. Counseling is a collaborative process, which involves the development of a unique, confidential help-oriented relationship. The CAAC treats all of its contacts with students in a highly confidential manner. The CAAC has a number of professionals specialized in social counseling. The center provides the following counseling services:

1. Individual Counseling: A student meets with a counselor on a one-to-one basis to work through personal concerns.
2. Group Counseling: Counseling in groups offers a broad range of insight and support from peers and professional counselors.
3. Couples Counseling: Couples counseling works toward alleviating the strains in a close relationship. In such cases, one of the relatives, usually the father or a brother, are contacted and asked to visit the center.

The campus medical center in the university provides professional counseling when necessary through a psychiatry physician. It also provides transferring to other around hospitals.

1.4. Transfer Students and Transfer Courses

The transfer of a student from outside KFUPM may be accepted under the following conditions:

4. The student should have been enrolled at a recognized college or university.
5. The student must not have been dismissed from that institution for disciplinary reasons.
6. The student must satisfy the transfer provisions as determined by the University Council.

All transfer applications are submitted to the Admission and Academic Standing Committee, which evaluates and ensures that the applicant fulfills the mentioned requirements. This is in addition to any other provisions the committee deems necessary, in coordination with the colleges concerned. If, after his transfer, it is discovered that a student had been dismissed from his previous university for disciplinary reasons, his enrollment will be considered canceled as from the date of acceptance of his transfer to the University.

Transfer students are evaluated as follows:

- If a student wishes to transfer courses from another university, the Deanship of Admissions and Registration forwards to all concerned departments the relevant materials for evaluation and stating the courses the student desires credit in.

- The Department chairman requests the curriculum committee chairman to perform these evaluations and to maintain consistency in evaluating transfers.
- The College Council reviews the courses taken by the student outside the University based on the recommendations of the department, which offers equivalent courses.
- If the student has earned grades of 'C' or the equivalent or higher in courses taken at a recognized university which are judged sufficiently equivalent to individual course requirements listed in the student's chosen degree program at KFUPM, the corresponding KFUPM courses are waived and the "C" grade or above gained elsewhere are transferable as pass grades.
- The evaluation of academic transcripts from other institutions is done by the academic department concerned.
- The Deanship of Admissions & Registration coordinates this evaluation for the final transfer of credits.
- To qualify for an undergraduate degree: from KFUPM, a student must complete a minimum of 36 semester-credit hours of course work at KFUPM, including a minimum of 18 credit-hours in his major (out of 131 credits for the COE program).

The detailed policies and regulations regarding credit transfer of students are described in the KFUPM Undergraduate Study and Examinations booklet.

Transfer within KFUPM colleges

A student may be transferred from another college to the program inside the university in accordance with University Council rules as follows:

1. A student may transfer from another college within the university into the program before he completes the sixth academic level.

2. The student should continue to study all the courses registered for at the level preceding the transfer, in compliance with the adding and dropping rules.

3. The transfer from one college to another will be recorded in the academic record of the student in the term following his transfer.

4. A student is allowed a maximum of two transfers from one college to another.

The academic record of a student transferred from one college to another includes all the courses he has studied together with the grades, the semester GPA and cumulative GPA obtained throughout his period of study at the university.

The KFUPM courses for which a student has been granted transfer credits do not count in the GPA calculations while he is registered at KFUPM.

In the COE Department, the chairman of the department requests the curriculum committee, through its chairman, to perform these evaluations. Also, this maintains

consistency in evaluating transfers. In all cases, the transfer students represent a very small percentage of the total COE students. Table 1.4-1 provides a list of the number of transfer students over the past five academic years.

Table 1.4-1. Transfer Students for Past Five Academic Years

Academic Year	Number of Transfer Students Enrolled
2008-09	2
2007-08	2
2006-07	7
2005-06	3
2004-05	7

Transfer within CCSE College

With the approval of the Dean of the College, a student may transfer from one department to another within the college according to the following rules:

1. A student may transfer at any time before he completes the sixth academic level. The College Council may consider exceptional cases where students have already completed the sixth level.

2. The transfer will be recorded in the academic record of the student at the beginning of the term following the transfer.

3. A student is allowed a maximum of two transfers within the same college. The college council may consider exceptional cases.

The academic record of a student transferring from one major to another will include all the courses the student has taken, including the grades, the semester GPA and cumulative GPA obtained throughout his period of study at the University.

1.5. Graduation Requirements

To become eligible for a Bachelor of Science degree in an engineering program, a student must fulfill the following requirements:

1. Cumulative and major GPAs of 2.00 or higher on a 4.00 point scale.
2. Completion of the number of semester-credit-hours required by the COE program.
3. Completion of the prescribed and elective academic work required by the department. (Total of 130 credit hours are required for “BSc without COOP” and 131 credit hours are required for “BSc with COOP” as shown in Table 1.5-1 and Table 1.5-2, respectively.

Every student follows a degree plan to monitor progress through his program and to certify that all graduation requirements are fulfilled.

KFUPM’s registrar office prepares a document called degree audit for every student. The degree audit is a summary of the individual student's graduation status. It contains a list of all courses that must be completed by the student to meet the graduation requirements of his chosen major. The student indicates which of those courses have actually been completed, which are left to be completed, and an estimated graduation time, given normal semester course loads. In summary, the Academic Department Head and the Registrar are jointly responsible to ensure that all students meet the program requirements.

Table 1.5-1. BS Regular Program (Without COOP)

First Year (Preparatory)

Course Num.	Title	LT	LB	CR	Course Num.	Title	LT	LB	CR
MATH-001	Preparatory Math I	3	1	4	MATH-002	Preparatory Math II	3	1	4
ENGL-001	Preparatory English I	15	5	8	ENGL-002	Prep. English II	15	5	8
PE-001	Prep Physical Educ. I	0	2	1	PE-002	Prep. Physical Educ. II	0	2	1
ME-001	Prep. Shop I	0	2	1	ME-002	Prep. Shop II	0	2	1
Total		18	10	14			18	10	14

Total Credits required in Preparatory Program: 28

Second Year (Freshman)

Course Num.	Title	LT	LB	CR	Course Num.	Title	LT	LB	CR
MATH-101	Calculus I	4	0	4	MATH-102	Calculus II	4	0	4
PHYS-101	General Physics I	3	3	4	PHYS-102	General Physics II	3	3	4
CHEM-101	General Chemistry I	3	4	4	ICS-102	Introd. to Computing	2	3	3
ENGL-101	English Composition I	3	0	3	ENGL-102	English Composition II	3	0	3
IAS-111	Belief and its Consequences	2	0	2	IAS-101	Practical Grammar	2	0	2
					PE-101	Physical Education I	0	2	1
Total		15	7	17			14	8	17

Third Year (Sophomore)

Course Num.	Title	LT	LB	CR	Course Num.	Title	LT	LB	CR
COE-202	Digital Logic Design.	3	0	3	COE-205	Comp. Org. & Ass. Lang.	3	3	4
EE-201	Electric Circuits I	3	3	4	COE-203	Dig. Design Lab.	0	3	1
ICS-201	Introduction to CS	3	3	4	ICS-202	Data Structures	3	3	4
MATH-201	Calculus III	3	0	3	ICS-252	Discrete Mathematics	3	0	3
IAS-211	Ethics in Islam	2	0	2	MATH-260	Intro. Lin. Alg. & Dif. Equ.	3	0	3
PE-102	Physical Education II	0	2	1	ENGL-214	Tech. Report Writing	3	0	3
Total		14	8	17			15	9	18

Fourth Year (Junior)

Course Num	Title	LT	LB	CR	Course Num	Title	LT	LB	CR
COE-305	Microcomp. Syst. Design	3	3	4	COE-308	Computer Architecture	3	0	3
STAT-319	Prob &Stat. For Eng.&Sc.	2	3	3	COE-344	Computer Networks	3	3	4
COE-341	Data & Computer Comm.	3	0	3	COE-390	Seminar	1	0	1
COE/ICS/ SWE-Xxx	IT Elective	3	0	3	EE-203	Electronics I	3	3	4
					yyy-yyy	Free Elective	3	0	3
IAS-201	Objective Writing	2	0	2	IAS-311	Islamic Shareah	2	0	2
Total		13	6	15			15	6	17
COE-399	COE Summer Training	0	0	0					

Fifth Year (Senior)

Course Num.	Title	LT	LB	CR	Course Num.	Title	LT	LB	CR
COE-485	Senior Design Project	1	6	3	COE-400	System Design Lab	1	6	3
COE-4xx	COE Elective	3	0	3	COE-4xx	COE Elective	3	0	3
ICS-431	Operating Systems	3	3	4	zzz-zzz	General Elective	3	0	3
COE-360	Principles of VLSI Desg.	3	0	3	xxx-xxx	General Elective	3	0	3
IAS-301	Literary Styles	2	0	2	IAS-4xx	IAS Elective	2	0	2
Total		15	9	15			12	6	14

Total Credits required in COE B.S. Degree Program is: 130

Table 1.5-2. BS Regular Program (With COOP)

First Year (Preparatory)

Course Num.	Title	LT	LB	CR	Course Num.	Title	LT	LB	CR
MATH-001	Preparatory Math I	3	1	4	MATH-002	Preparatory Math II	3	1	4
ENGL-001	Preparatory English I	15	5	8	ENGL-002	Prep. English II	15	5	8
PE-001	Prep Physical Educ. I	0	2	1	PE-002	Prep. Physical Educ. II	0	2	1
ME-001	Prep. Shop I	0	2	1	ME-002	Prep. Shop II	0	2	1
Total		18	10	14			18	10	14

Second Year (Freshman)

Course Num.	Title	LT	LB	CR	Course Num.	Title	LT	LB	CR
MATH-101	Calculus I	4	0	4	MATH-102	Calculus II	4	0	4
PHYS-101	General Physics I	3	3	4	PHYS-102	General Physics II	3	3	4
CHEM-101	General Chemistry I	3	4	4	ICS-102	Introd. to Computing	2	3	3
ENGL-101	English Composition I	3	0	3	ENGL-102	English Composition II	3	0	3
IAS-111	Belief and its Consequences	2	0	2	IAS-101	Practical Grammar	2	0	2
					PE-101	Physical Education I	0	2	1
Total		15	7	17			14	8	17

Third Year (Sophomore)

Course Num.	Title	LT	LB	CR	Course Num.	Title	LT	LB	CR
COE-202	Digital Logic Design	3	0	3	COE-205	Comp. Org. & Ass. Lang.	3	3	4
EE-201	Electric Circuits I	3	3	4	COE-203	Dig. Design Lab.	0	3	1
ICS-201	Introduction to CS	3	3	4	ICS-202	Data Structures	3	3	4
MATH-201	Calculus III	3	0	3	ICS-252	Discrete Mathematics	3	0	3
IAS-211	Ethics in Islam	2	0	2	MATH-260	Introduction to Linear Algebra & Diff. Equ.	3	0	3
PE-102	Physical Education II	0	2	1	ENGL-214	Technical Report Writing	3	0	3
Total		14	8	17			15	9	18

Fourth Year (Junior)

Course Num.	Title	LT	LB	CR	Course Num.	Title	LT	LB	CR
COE-305	Microcomp. Syst. Design	3	3	4	COE-308	Computer Architecture	3	0	3
STAT-319	Prob &Stat. For Eng.&Sc.	2	3	3	COE-344	Computer Networks	3	3	4
COE-341	Data & Computer Comm.	3	0	3	COE-390	Seminar	1	0	1
COE/ICS /SWE-xxx	IT Elective	3	0	3	COE-360	Principles of VLSI Desg.	3	0	3
EE-203	Electronics I	3	3	4	ICS-324	Data Base Systems	3	3	4
IAS-201	Objective Writing	2	0	2	IAS-311	Islamic Shareah	2	0	2
Total		16	9	19			15	6	17
COE-350	Cooperative work	0	0	0					

Fifth Year (Senior)

Course Num.	Title	LT	LB	CR	Course Num.	Title	LT	LB	CR
COE-351	COOP. Work (cont.)	0	0	9	COE-400	System Design Lab.	1	6	3
					COE-4xx	COE Elective	3	0	3
					ICS-431	Operating Systems	3	3	4
					xxx-xxx	General Elective	3	0	3
					IAS-301	Literary Styles	2	0	2
					IAS-4xx	IAS Elective	2	0	2
Total		0	0	9			14	9	17

Total Credits required in COE B.S. Degree Program with COOP is: 131.

1.6. Enrollment and Graduation Trends

Table 1.6-1 shows enrollment trends for the last five academic years. Table 1.6-2 gives a listing of the last 25 BSc graduates from the COE program.

Table 1.6-1 . Enrollment Trends for Past Five Academic Years

	Year (2004-2005)	**Year (2005-2006)**	**Year (2006-2007)**	**Year (2007-2008)**	**Year (2008-2009)**
Full-time Students	572	443	336	255	204
Graduates	142	129	81	62	28

Table 1.6-2. Program Graduates

Numerical Identifier	Year Matriculated	Year Graduated	Initial or Current Employment/ Job Title / Other Placement
199185720	1994-1995	2008-2009	N/A
199927360	2000-2001	2008-2009	N/A
200030620	2001-2002	2008-2009	N/A
200065010	2001-2002	2008-2009	N/A
200065270	2001-2002	2008-2009	N/A
200121370	2002-2003	2008-2009	N/A
200123790	2002-2003	2008-2009	N/A
200151010	2002-2003	2008-2009	N/A
200236360	2003-2004	2008-2009	N/A
200242900	2003-2004	2008-2009	N/A
200243040	2003-2004	2008-2009	N/A
200246360	2002-2003	2008-2009	N/A
200249760	2003-2004	2008-2009	N/A
200250600	2003-2004	2008-2009	N/A
200319350	2004-2005	2008-2009	N/A
200324150	2004-2005	2008-2009	N/A
200324830	2003-2004	2008-2009	N/A
200331390	2004-2005	2008-2009	N/A
200373190	2004-2005	2008-2009	N/A

200376310	2004-2005	2008-2009	N/A
200376390	2004-2005	2008-2009	N/A
200376710	2004-2005	2008-2009	N/A
200376830	2004-2005	2008-2009	N/A
200376970	2004-2005	2008-2009	N/A
200379250	2004-2005	2008-2009	N/A

CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

ABET defines program educational objectives (PEOs) as “broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve”. PEOs are measures of the graduates’ performance 3 to 5 years after completing the program. PEOs have to be consistent with the mission of the institution. Various program constituents have to be involved in the development, periodic revision, and assessment of the PEOs. This section presents PEOs of the Computer Engineering Program (COE) and discusses their alignment with the institution mission. Also, it describes the processes used to establish, assess and evaluate them. Relevant supporting documents and evidence are collected in a folder named "Criterion 2", which is available in the assessment committee office.

The Program Educational Objectives (PEOs) of the Department of Computer Engineering (COE) are supported by the COE program learning outcomes in accordance with the declared missions of KFUPM and the College of Computer Sciences and Engineering (CCSE).

The KFUPM and CCSE mission and the CCSE objectives, which drive the education and shape the identity of the engineering graduates of the Computer Engineering (COE) department, are reviewed in the following paragraphs.

2.1. Mission Statement

The PEOs are developed to ensure proper contribution of the program to fulfill the following university, college and the COE department mission statements:

The University Mission

KFUPM, founded in 1963, is one of the most prestigious institutions of higher education in the Middle East region. As one of the distinguished technical universities in the Kingdom of Saudi Arabia, the resources of the university constitute an invaluable asset for the intellectual, economic, and social enrichment of the Kingdom.

As an institution of higher learning, the KFUPM is committed to (University Mission):

a. Preparing professionals empowered with the knowledge, skills, values and confidence to take a leadership role in the development of the Kingdom in the fields of science, engineering, environmental design and business.

b. Producing research that contributes to the knowledge and sustainable development of the Kingdom and the region by providing innovative solutions to identified economic and technical problems and opportunities.

c. Providing a stimulating campus environment for the welfare of its students, faculty and staff, and offering outstanding professional services and out-reach programs to the society at large

The mission of KFUPM is posted on its web site at:

http://www.kfupm.edu.sa/opq/University_Mission_Vision_Values.html

The College Mission

The College of Computer Sciences & Engineering (CCSE) was created in 1986. It was the result of a reorganization aimed at grouping together computer-related disciplines to better serve the development plans of the Kingdom.

The mission of the college of Computer Sciences and Engineering is:

a. To prepare competent professionals in the areas specified in the college line of business who are competitive worldwide and will be the leaders in Saudi industry, academia and government.

b. To conduct innovative basic and applied research that advances the frontiers of knowledge and addresses local problems.

c. To provide high quality service to society in the areas of applied projects, consultation and training.

The mission of CCSE is posted on its web site at:

http://www.ccse.kfupm.edu.sa/ccse-web/pages/page.php?page=Strategic_Plan

The Department Mission

The mission of the Computer Engineering Program at KFUPM is to develop and train the human intellect needed for meeting the continued technological advances in the discipline of Computer Engineering and IT-related areas. This includes graduating well-trained computer engineers to participate in the industrial development which is taking place in the Kingdom of Saudi Arabia.

The mission of the COE is posted on the following web site:

http://www.ccse.kfupm.edu.sa/coe/abet/mission.html

2.2. Program Educational Objectives

In consistency with the missions of the University, the CCSE and the COE department, the following Educational Objectives were adopted for the Computer Engineering Program:

The objectives of the **Computer Engineering Program (COE)** are to produce computer engineering graduates who are prepared to:

1. Practice their profession with confidence and global competitiveness and make intellectual contributions to it;

2. Pursue a life-long career of personal and professional growth with superior work ethics and character, and
3. Pursue advanced study and research at the graduate level.

These PEOs were proposed to the COE Department Council in November 2006 after an elaborate discussion of an initial set of PEOs that were proposed by a departmental subcommittee commissioned for this task. Moreover, the COE department council has discussed and ratified an assessment strategy together with a review process to evaluate the extent to which the COE program achieves these PEOs. The assessment strategy and review process involve the COE department constituency at various levels as will be detailed in the coming sections.

The departmental faculty council approved the Computer Engineering PEOs in its meeting # 6/1429-30H (2008-2009), dated 1/2/2009. The PEOs of the Computer Engineering Program are published on the departmental web site at:

http://www.ccse.kfupm.edu.sa/coe/abet/objectives.html

The PEOs are in full alignment with the university mission statements**.** In particular, PEOs of the COE program are linked directly to point (a) of the university mission. Consistency of the COE PEOs with the missions of KFUPM, CCSE, and COE is further elaborated in the next Sections.

2.3. Consistency of the Program Educational Objectives with the Mission of the Institution

The Computer Engineering PEOs are closely linked to, and consistent with, the KFUPM and CCSE missions. For instance, KFUPM and CCSE missions are directly served by the first and second COE PEOs, while the third PEO directly serves the above two mission statements.

Specifically, the PEO 1 supports the expected leadership and global competitiveness roles of COE graduates' in the development of the Kingdom in the field of Computer Engineering. PEO 2 ensures the qualities for self-development and professional growth and addresses responsibilities and ethical values. PEO 3 describes how the broad knowledge, skills, and practices acquired during the course of study serve as the basis for quality research during graduate studies. Therefore, these three program educational objectives contribute indirectly to the accomplishment of the university mission statement.

The COE PEOs are aligned with the department’s mission. PEO 1 provides the first step towards a career of achievement and service. The needed background of knowledge and skills are acquired to achieve PEO 1. Students acquire quality education through several avenues, including knowledge, skills and values as reflected in PEO 1 and 2. The professional and ethical issues are also preserved in PEO 2. The COE program provides enough depth, breadth and elective courses that are needed at graduate schools, which contribute to PEO 3.

2.4. Program Constituencies

The program constituents are those who must be *satisfied* with the performance of the COE program. The significant groups of constituencies of the COE program are:

1. Faculty: COE faculty members are involved on regular basis in the assessment processes.
2. Students: Current COE students are interested in whether the COE program adequately prepares them for future employment.
3. Alumni: This group consists of recent graduates who have been employed for at most two years and graduates who have been employed for 3 to 5 years. Graduates with work experience of 3 to 5 years constitute a key part of the assessment process. They should have the incentives to assess the quality of PEOs based on their career achievements.
4. Employers (government, industry and universities): Employers' satisfaction with our students' education provides measure of the program success. Their satisfaction translates to employment opportunities for our students.

To support the program, the COE has formed the Industrial Advisory Committee (IAC). The committee includes professionals in the field of Computer Engineering from industry, government and academia. The IAC participated effectively in the refinement and assessment processes of the PEOs. The committee members meet once a year with the department and the assessment committee chairmen to review program developments, and to participate in the assessment and evaluation of the program. IAC is chaired by the department chairman and includes six members from the industry and four COE faculty members; as detailed in Table 2.4-1.

Table 2.4-1 . Industry Advisory Committee Membership

	Industry Advisory Committee	Role	Title and Affiliation
1	Dr. Adnan Gutub	Chairman	Associate Professor, Chairman of the COE Department, KFUPM, Dhahran 31261, KSA
2	Dr. Khalid Al-Biyari	Member	Senior Vice President, Advanced Electronic Company, PO Box # 90916, Riyadh 11623, KSA.
3	Mr. Ali A. Al-Masari,	Member	Superintendent, Communications Operations Department Saudi Aramco, P.O. Box. 1297, Dhahran 31311, KSA
4	Mr. Masud Eid Al-Amiri	Member	General Manager, Information Technology Services SABIC, Riyadh 11422, Saudi Arabia.
5	Mr. Ahmad Ashadawi,	Member	President, Al-Falak Electronic Equipment & - Supplies Co, Al-Khobar, KSA.
6	Mr. Alaa Abunijem,	Member	MS, PMP, Energy Team lead and Strategic Relations Manager, Middle East, Turkey and Africa, Intel Corporation, PO Box 7247, Riyadh 11462, KSA
7	Mr. Aiman H Mufti,	Member	Supervisor, Technical Knowledge Sharing Unit, Engineering Knowledge & Resources Division, Saudi Aramco, Dhahran, KSA.
8	Dr. Mayez Al-Mouhamed	Member	Professor, Computer Engineering Department KFUPM, Box No. 787, Dhahran 31261, KSA.
9	Dr. Aiman El-Maleh,	Member	Associate Professor, Computer Engineering Department KFUPM, Box No.1063 , Dhahran 31261, KSA.
10	Dr. Ashraf Mahmoud	Member	Assistant Professor, Computer Engineering Department KFUPM, Box No. 1724, Dhahran 31261, KSA.
11	Dr. Basem Almadani	Member	Assistant Professor, Computer Engineering Department KFUPM, Box No .1195, Dhahran 31261, KSA.

2.5. Process for Establishing Program Educational Objectives

PEO Definition

The process of defining the PEOs started in 2001-2004 during the self assessment process undertaken by the COE department. The Program Educational Objectives are drawn up in an engaging process involving constituents within the broader context of the institutional mission which are the department, the college and the University missions. The mission and of the University, College, and department were to instill in its graduates a solid foundation of mathematical, scientific, and engineering knowledge in addition to developing the intellectual skills essential for excelling in their careers. The first PEOs were defined altogether with a set of seven program outcomes. The assessment committee has developed a set of PEOs aligned with the program mission. The PEOs were discussed with all faculty members in several departmental meetings. This process has resulted in the PEOs listed below:

1. **Objective #1**: To provide students with a solid foundation in the Computer Engineering discipline and design methodologies through emphasis on the application of mathematical, scientific, and engineering principles.

2. **Objective #2:** To provide students with the skills needed to join the workforce well prepared in Computer Engineering core competencies. Graduates of the Computer Engineering Department should be able to:

    a. Utilize and develop skills pertinent to engineering design, including the identification, analysis, and solution of professional problems through the use of appropriate analytical, computational and experimental tools.
    b. Formulate engineering technological solutions to meet societal needs using computer engineering principles, tools, and practices.
    c. Design, operate, maintain, and upgrade computer systems or networks as well as understand their interaction and impact on the society.
    d. Link theory with practice and demonstrate analytical and proper decision making abilities while developing engineering systems or solutions.
    e. Demonstrate proven engineering ability in the discipline by demonstrating showing their ability to synthesize hardware/software schema for computer engineering problems.
    f. Demonstrate recognizable quality in critical and independent thinking skills.
    g. Engage in life-long learning and demonstrate leadership in their chosen careers.
    h. Demonstrate good communication skills both in report writing and in technical presentation.

3. **Objective #3:** To provide students with the knowledge of proper ethical and professional practices relevant to Computer Engineering, as well as awareness of the societal impact of computer technologies.

The first objective is aligned with the Department's mission of providing the best quality education in Computer Engineering. The second objective focuses on the skills and opportunities provided to Computer Engineering graduates in terms of core competencies such as engineering design analytical skills, as well as critical and independent thinking skills. The third objective is aligned with the College and Department mission of addressing the needs of the local industry and the society, through producing computer engineers who are not only technically competent but also ethically and professionally capable of introducing new strategic computer industries and markets in the Kingdom of Saudi Arabia.

Since the last ABET visit to the COE department in 2001, the COE program has undergone several cycles of assessment-improvement cycles. Indeed, the assessment methods and procedures themselves have gone through several evolutions including the alignment to ABET EC 2K. Following a review of the ABET Criteria and the University and College missions, the COE faculty redefined the COE Program Educational Objectives in their current form. The PEOs were presented and discussed in the COE Department Councils and IAC. The COE faculty and IAC approved the PEOs in 2006-2007. Minutes of the meetings are available in "IAC" folder.

PEOs Review

The PEOs review process consists of periodically documenting and demonstrating that the PEOs are based on the needs of the program's various constituencies. The review process of the COE department PEOs is conducted every three years (the curriculum revision cycle) with the next review due in the academic year 2009-2010. However, assessing the extent to which the PEOs are achieved is, however, an ongoing process through various assessment tools. Every three year, assessment data collected from the various sources will be compiled, analyzed, and corrective actions and/or refinements of the PEOs will be conducted as needed. Following is a list of the assessment tools that are used for this purpose.

PEO Assessment Tools

Figure 2.5-1 shows the review process of the PEOs. Alumni surveys seek to find out how alumni perceive the program PEOs and how the program meet the needs and challenges of the work environment. Employers' surveys are designed to determine how employers judge COE graduates in meeting job requirements and needs. The faculty review the results from the assessment process and may revise the PEOs. The IAC input is sought on the above revisions on an annual basis through direct meetings, discussions and surveys.

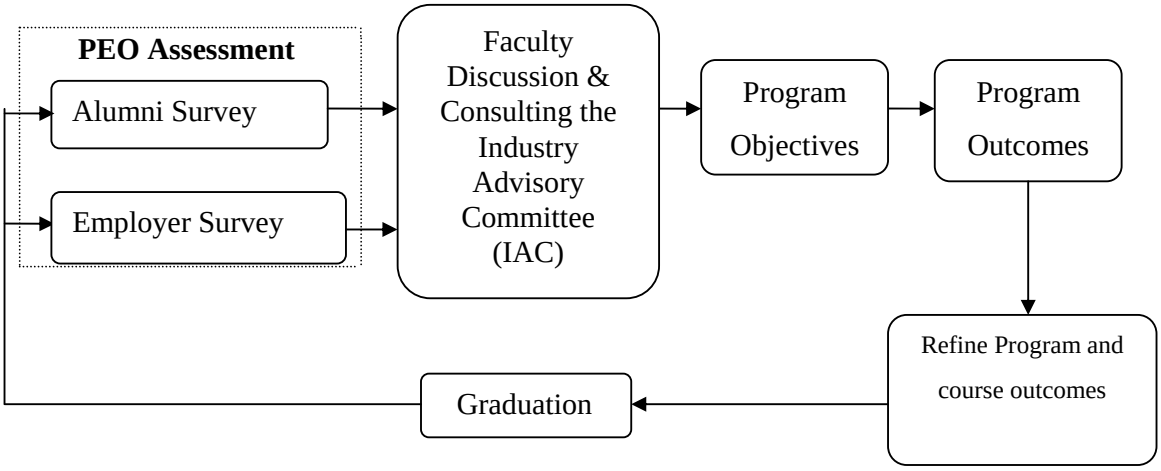


Figure 2.5-1. Overview of the PEOs Assessment Process

Employer input is collected through two mechanisms:

a. Once every three years: Direct surveys of known employers of COE graduates (preferably at the executive level).

b. Once every semester: Supervisors of COE COOP students are asked to fill a direct survey in addition to an evaluation form for each student. The survey includes mainly addresses the COE Program Outcomes but also touches on the COE PEOs.

Alumni input regarding the COE PEOs and learning outcomes is collected every three years through surveys.

Planning the PEOs Review Process

The review process of the PEOs is carried out once every three years as shown on Table 2.5-1. The PEOs Assessment cycle is 3 years:

Table 2.5-1. Planning the review process of the PEOs

Planning PEOs Review Process and Frequency	**2006-2007 (T061-062)**	**2007-2008 (T071-072)**	**2008-2009 (T081-082)**	**2009-2010 (T091-092)**
Review of the Program Educational Objectives PEOs (every 3 years)	X			X (Based on Survey data collected in 2008-2009)

2.6. Achievement of Program Educational Objectives

The PEOs were implemented in the COE program in the academic year 2006-2007. It is reasonable to allow three years or more before we carry out an assessment of these PEOs.

It can be reasonably assumed that when the PEOs meet the needs of alumni and employers, then students will be satisfied. A copy of employer and Alumni surveys will be presented as part of the display material. Apart from the address information, the alumni survey form is basically the same as the employers counterpart.

Alumni Survey

We have deployed the Alumni Survey in T062 and T082 to get feedback on how the COE program is successful in addressing the PEOs in the views of the COE alumni who completed their COE BSc degree before implementing the new PEOs.

The latest graduating alumni survey was performed on graduate in 2007-2008. Our PEOs were developed in 2006-2008 and it reasonably takes no less than 6 years to relate the alumni survey to our current PEOs. For this reason the current alumni survey is useful in relating the success of alumni who graduated prior to establishing our current PEOs. Although this limits the validity of using the survey for PEOs assessment we use the alumni concerns and compare to curricular corrections that were made in past two years.

Table 2.6-1 shows the PEOs in first column, and the survey questions that map to each PEO in second column. The percentage of responses alumni were very satisfied, satisfied, neutral, dis-satisfied, and very dis-satisfied, are shown in columns 3 to 7. The combined percentages of responses for “Very satisfied or Satisfied” (VSS) and “Very Satisfied, Satisfied, and Neutral” (VSSN) are shown in columns 8 and 9,

respectively. Both the VSSN and VSS alumni satisfaction percentiles are summarized in Figure 2.6-1 and Figure 2.6-2.

In T062 and T082, 50 and 90 Alumni responded to the survey, respectively. Referring to the VSSN score, the alumni satisfaction level for all PEOs exceed 74%. The least rated program aspects questions which received a score below 80% were the same for both terms. In the following we list the least rated program aspects (top is the least achieved):

- PEO-1-4: The COE program has provided me with adequate background to improve my personal skills (e.g., teamwork, leadership, oral and written communication skills, etc) in the work place.
- PEO-1-2: The COE program has provided me with adequate background to be globally (worldwide) competitive in my profession.
- PEO-1-6: The COE program has provided me with adequate technical depth.

We note that all of the above questions fall in PEO-1. The curricular actions taken in the last two years addressed the above concerns. In T081 and T082, we conducted corrective actions to improve the (1) Engineering Design aspects including teamwork and other personal skills and (2) the Communication Writing Skills (see Section on Criterion 3). We noticed an improvement in T082 for the first action. The COE program and curriculum is now aligned with ABET 2008-2009 Criterion in order to provide globally competitive education. Several COE elective courses were added in the Networking Area (five courses) and Computer Architecture and Embedded Systems (2 courses) to enhance technical depth in the program.

Table 2.6-1. Alumni Survey for T062 and T082

Alumni Survey Question Versus Category Percentage (T062: data row1, T082: data row 2)		Very Satisfied (5)	Satisfied (4)	Neutral (3)	Dis-satisfied (2)	Very Dis-satisfied (1)	**VSS**	**VSSN**
PEO-1	1. The COE program has provided me with adequate background to practice my profession as a computer engineer with confidence.	18.8 13.33	54.55 47.78	13.64 27.78	11.36 7.78	2.27 3.33	73.35 61.11	86.99 88.99
	2. The COE program has provided me with adequate background to be globally (worldwide) competitive in my profession.	6.82 7.78	56.82 43.33	15.91 25.56	9.09 14.44	11.36 8.89	63.64 51.11	79.55 76.67
	3. The COE program has provided me with adequate background to make intellectual contribution to my profession.	13.64 16.67	61.36 36.67	15.91 35.56	6.82 7.78	2.27 3.33	75.0 53.34	90.91 88.90
	4. The COE program has provided me with adequate background to improve my personal skills (e.g., teamwork, leadership, oral and	22.73 23.33	29.55 26.67	27.27 24.44	13.64 15.56	6.82 10.0	52.28 50.0	79.55 74.44

	written communication skills, etc) in the work place.							
	5. The COE program has provided me with adequate technical breadth.	9.09 10.0	54.55 41.11	29.55 33.33	4.55 8.89	2.27 6.67	63.64 51.11	93.19 84.44
	6. The COE program has provided me with adequate technical depth.	11.36 12.22	38.64 33.33	27.27 33.33	15.91 15.56	6.82 5.56	50.0 45.55	77.27 78.88
PE-2	1. The COE program has provided me with adequate opportunities to help me understand and appreciate the importance of superior work ethics in the practice of my profession.	25.0 22.22	38.64 31.11	15.91 33.33	20.45 11.11	0.0 2.22	63.64 53.33	79.55 86.60
	2. The COE program has provided me with adequate opportunities to help me understand and appreciate the importance of good character in the practice of my profession.	13.64 21.11	47.73 31.11	22.73 27.78	13.64 14.44	2.27 5.56	61.37 52.22	84.10 80.0
PE-3	1. The COE program has provided me with adequate ability and motivation to continuously improve my technical skills.	29.55 25.56	47.73 43.33	13.64 14.44	6.82 7.78	2.27 8.89	77.28 68.89	85.92 83.39
	2. The COE program has provided me with adequate training for professionally adapting myself to changes in my field.	34.09 26.67	38.64 44.44	20.45 23.33	2.27 3.33	4.55 2.22	72.73 71.44	93.18 94.77
	3. The COE program has provided me with adequate background that I can build on to continue higher studies for the MS and PhD degrees.	20.93 24.44	39.53 31.11	20.93 24.44	6.98 11.11	11.63 8.89	60.46 55.55	81.39 79.99

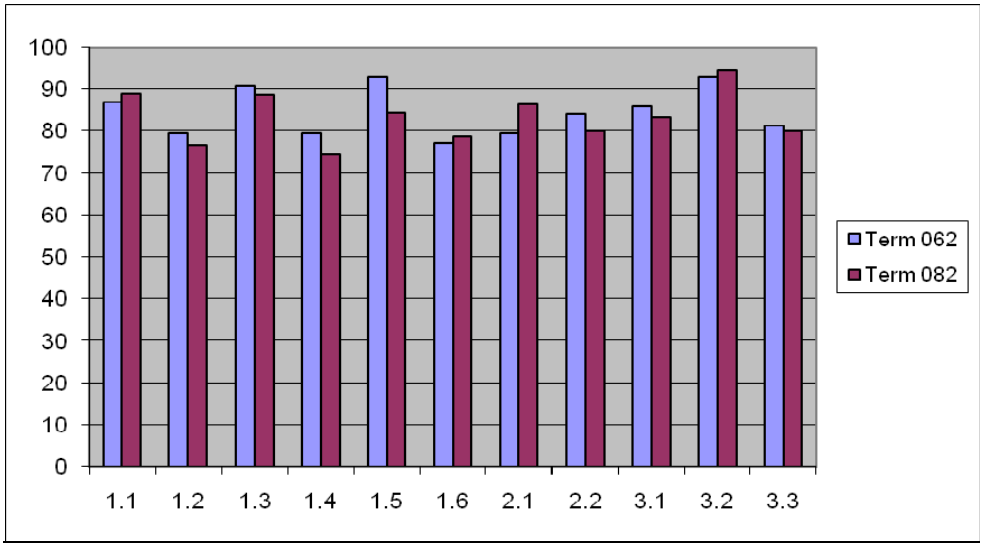


Figure 2.6-1. VSSN Alumni satisfaction percentile vs PEO-1(1.1-1.6), PEO-2 (2.1-2.2), and PEO-3 (3.1-3.3)

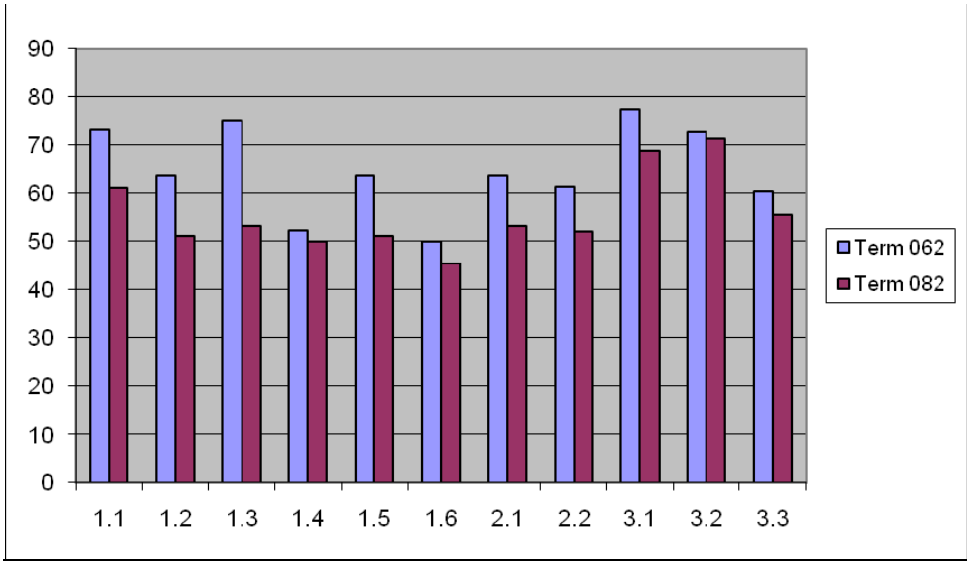


Figure 2.6-2. VSS Alumni satisfaction percentile vs PEO-1(1.1-1.6), PEO-2 (2.1-2.2), and PEO-3 (3.1-3.3)

The next least rated program aspects for both surveys marginally which achieve the 80% level for both terms T062 and T082 are the following:

- PE-2-1: The COE program has provided me with adequate opportunities to help me understand and appreciate the importance of superior work ethics in the practice of my profession.
- PE-3-2: The COE program has provided me with adequate training for professionally adapting myself to changes in my field.

We have added a core course on Ethics (IAS 212) to the COE Program and emphasized the application of ethics within the framework of culminating design experience courses like the COE 485 "Senior Design Project" and COE 400 "Embedded Systems". A course on Database was recommended prior to engaging in the COOP program. Also Engineering Design Aspects are currently emphasized to the students through the COOP to improve student training through the COOP.

We have also consulted the IAC on the PEOs in 2007 and 2009. They all approved our PEOs. All the IAC members indicated that we have adequate PEOs. We collected the following input on the COE PEOs:

1. The nature of our business is to have engineers with both business and engineering backgrounds. This way the graduates can communicate with our staff and understand business issues commercially and financially. These are the only issues we have and feel we are lucky.
2. Good objectives, however, you need some focus on a few areas to shine in and gain regional and world-wide reputation. There is a breadth but not much depth in the overall objectives.

3. Provide graduate engineers with ability of supporting the industry in the following fields: Communication network design and Embedded system design

It is clear that the curricular actions taken in addressing the Alumni concerns are also addressing the IAC recommendations. Minutes of the IAC meetings and discussion sessions will be part of the display material.

Employer Survey

We have deployed the Employer Survey in T082 to get feedback on how the COE program is successful in addressing the PEOs. We used the employer electronic addresses available at the University Student Affairs. We received a number of employer replies stating that they do not employ COE graduates. Only four survey were filled. We plan to ask our alumni in Term 091-092 to identify their employers to overcome the above inconvenience.

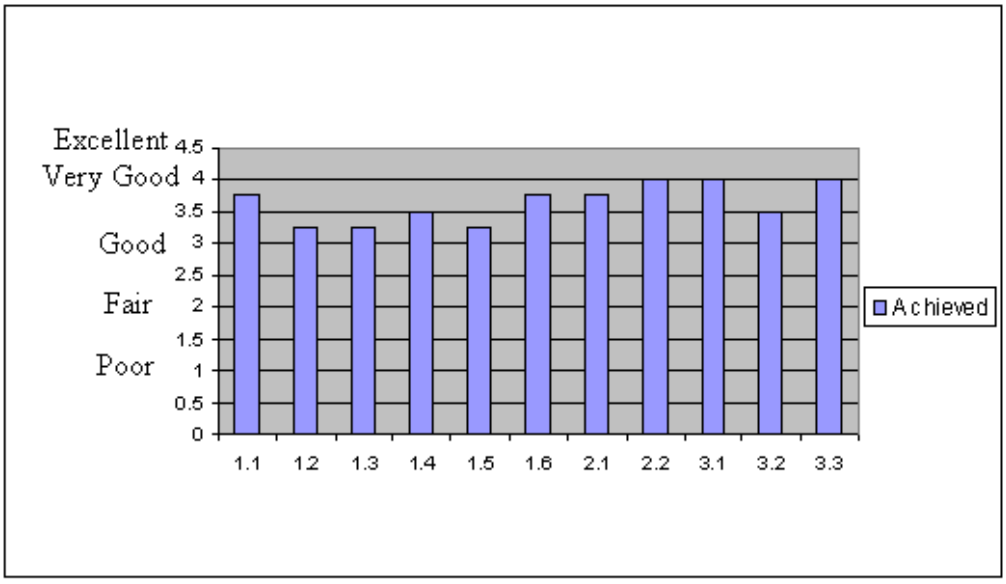


Figure 2.6-3. Employer satisfaction percentile vs PEO-1(1.1-1.6), PEO-2 (2.1-2.2), and PEO-3 (3.1-3.3)

Figure 2.6-3 shows the average employer rating for the achievement of the objectives using a scale of 5 (5: Excellent,.., 1:Poor). The employer satisfaction level for all PEOs exceed 65%. The least rated program aspects questions which received a score below 70% were the following (top is the least achieved):

- PEO-1-2: The COE program has provided its graduates with adequate background to be globally (worldwide) competitive in their profession.
- PEO-1-3: The COE program has provided its graduates with adequate background to make intellectual contribution to their profession.
- PEO-1-5: The COE program has provided its graduates with adequate technical breadth.

We note that all of the above questions fall in PEO-1. PEO-1-2 was previously addressed based on the Alumni feedback. For PEO-1-3 and PEO-1-5. The COE program has four areas: (1) computer networks and communication, (2) computer architecture and embedded systems, (3) VLSI, and (4) computer applications. Moreover, the COE program has been revised in 2008-2009 (not approved yet) to allow three COE elective courses to provide depth and breadth. New courses were introduced: Computer System Performance COE 402, Inter-network Design and Management COE 444, Mobile Computing COE 446, Network Security Engineer COE 449, Data Management COE 499, Introduction to Robotics COE 484, Parallel Computing COE 420, and Advanced Microprocessor Systems COE 403. The faculties are also discussing improving the COE program in the following directions: (1) Practice of Engineering Design, (2) Problem solving with some emphasis on Mathematical Analysis, (3) Business Analysis, (4) Advanced Database systems (specifically multi-dimensional databases), (5) Business Management and Finance to better prepare the COE graduates for the local industry.

Conclusion

In conclusion, the alumni and employer surveys proved useful in relating the success of alumni who graduated prior to establishing our current PEOs. Although the PEOs were developed in 2006-2008, the Alumni survey allowed us to carry out a number of corrective actions to enhance our program with respect to achievement of the PEOs. Based on the assessment results, it is clear that all of surveyed COE Alumni have rated the achievement of the COE PEOs favorably. Their rating exceeds a satisfaction level of 74.4%. We feel this process will facilitate the achievement of the PEOs though taking corrective curricular actions over time.

CRITERION 3. PROGRAM OUTCOMES

The ABET Engineering Accreditation Commission Criteria for 2008-2009 defines the Program Outcomes as statements that describe what students are expected to know and be able to do by the time of graduation. They are related to skills, knowledge and behavior that students will acquire through the program. The Program outcomes support the Program Educational Objectives and the mission of the University, the college and the department.

3.1. Process for Establishing and Revising Program Outcomes

Establishing the Program Outcomes

The process of defining the PEOs and POs started in 2001-2004 during the self assessment process undertaken by the COE department. The broad objectives of the undergraduate program in Computer Engineering Program were to instill in its graduates a solid foundation of mathematical, scientific, and engineering knowledge, in addition to developing the intellectual skills essential for prosperity and success in their careers. Once the Program Educational Objectives were derived based on input of all program constituents, Program Outcomes were determined to cover the Program Educational Objectives. There are three PEOs for the COE Program (see Criterion 1). Based on the PEOs a set of seven POs were defined by the faculty. The POs should demonstrate that our graduates have ability to:

1. Apply math, science and problem solving techniques to formulate adequate engineering solutions for:
   a. Design new systems to meet certain specifications
   b. Formulate new hardware or software solutions to adapt technology to societal needs.
2. Design and conduct experiments, as well as analyze and interpret data.
3. Effectively utilize up-to-date tools for the design, modeling, analysis or verification of engineering systems.
4. Work Cooperatively in multidisciplinary teams to produce an integrated system.
5. Communicate effectively with superiors or subordinates through report writing as well as technical presentations.
6. Demonstrate active lifelong learning capabilities.
7. Uphold and demonstrate best standard of professional and ethical practice and responsibility.

Since the last ABET visit to the COE department, the COE program has undergone several assessment-improvement cycles. Indeed, the assessment methods and procedures themselves have gone through several evolutions including the alignment to ABET EC 2K. After a review of the ABET Criteria and the University and College missions, the COE faculty redefined the COE Program Educational Objectives (PEOs) to their current form.

The POs developed by the COE faculty were derived based on the COE PEOs and the (a to k) ABET outcomes. A methodology for assessing the program objectives and outcomes was established by the COE ABET committee. For each course a set of course outcomes were defined and mapped to the POs. The COE faculty studied this mapping and found it suitable for the COE Program. It has been decided to add three more outcomes that are specific for the COE discipline.

The new PEOs and POs were presented and discussed with all faculty members in several departmental council meetings in 2006-2007. The PEOs and POs were also presented and discussed in an IAC meeting which approved them in 2006-2007. the COE council approved the PEOs, POs, and the assessment plan in early 2009. Minutes of the meetings are available as part of the display material.

Revising the Program Outcomes

The ABET Assessment committee periodically presents the POs to the COE faculty council and the IAC for comments, particularly following PEOs revision. We also survey the alumni and employers regarding the adequacy of the POs. Although the alumni survey data alone is not sufficient to measure the achievement of POs, it does ask alumni the survey of also rate the importance of each of the outcomes. The process of revising the POs starts when there is enough evidence for the need for revision, or simply when some trends are observed by the COE faculty from analyzing the above surveys.

In 2008-2009, as part of an effort to integrate into the University assessment process, the COE POs were submitted for review by ABET, by a mock ABET Visitor to the COE program, and by the KFUPM Quality Assurance Committee. The review process has found the POs adequate. In its extension of substantial equivalency recognition, dated October 8, 2008, the chair of the International Activities Council, ABET, Inc. was satisfied with the COE PEOs and POs. In his feedback, he quoted "Overall, the program Outcomes and associated direct measures based assessment process is reasonable, but requires some refining". The rest of the feedback was mainly on the assessment process and its presentation in the self-study report, such as his comments: "the need for disclosing the rating process of learning using direct measures …".

All of the reviews external to the department have resulted in approval of the COE POs. Internal to the department, we have decided to focus on addressing weaknesses in our assessment system. We will present proposed changes for external review once we feel that the assessment of the existing outcomes has matured enough.

3.2. Program Outcomes

Following a review of the ABET Criteria and the program objectives, it has been decided by the Computer Engineering faculty that the ABET Criteria (a - k) encompass the spirit of our educational vision. Therefore, outcomes (a - k) were adopted as the Computer Engineering Program Outcomes in addition to three

additional outcomes as recommended by ABET criteria for Computer Engineering programs.

The Computer Engineering Program Outcomes are:

(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.
(d) an ability to function on multi-disciplinary teams (*Our interpretation of multidisciplinary teams includes teams of individuals with similar educational backgrounds focusing on different aspects of a project as well as teams of individuals with different educational backgrounds*).
(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 and societal context.
(i) a recognition of the need for, and an ability to engage in life-long learning (*Our interpretation of this includes teaching students that the underlying theory is important because the technology changes, coupled with enhancing their self-learning ability*).
(j) knowledge of contemporary issues (*Our interpretation of this includes presenting students with issues such as the impact of globalization, the outsourcing of both engineering and other support jobs as practiced by modern international companies*).
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
(l) knowledge of probability and statistics and their applications in computer engineering.
(m) knowledge of discrete Mathematics.
(n) the ability to design a system that involves the integration of hardware and software components.

It should be noted that outcomes (l) and (m) were added to the program outcomes because knowledge of probability, statistics, and discrete mathematics is considered important for computer engineers as recommended by ABET for computer engineering programs. Outcome (n) was added to the program outcomes in order to emphasize in our program integration aspects between hardware and software components in the design process. Such aspects are not covered by outcome (c) which focuses on design aspects in general.

3.3. Relationship of Program Outcomes to Program Educational Objectives

The program outcomes are closely linked to the program educational objectives. The relationship illustrating the program outcomes serving each objective is mapped in Table 3.3-1.

Table 3.3-1. Mapping between program outcomes and program educational objectives.

Program Educational Objectives	Program Outcomes
1. Practice profession with confidence and global competitiveness and make intellectual contributions to it	a, b, c, d, e, g, k, l, m , n
2. Pursue a life-long career of personal and professional growth with superior work ethics and character	f, i, h, j
3. Pursue advanced study and research at the graduate level	a, b, e, g, i, k

Below we describe the relation between Program Educational Objectives and Program Outcomes in more detail.

Objective 1: Practice the profession with confidence and global competitiveness and make intellectual contributions to it.

For computer engineering students to be able to practice their profession with confidence and global competitiveness, the students must have the basic and fundamental knowledge of mathematics, science and engineering and they should be able to apply such knowledge in formulating and solving computer engineering problems. They should be able to design appropriate experimental setups and know how to interpret and analyze collected data to help them investigate the problems at hand come up with effective solutions. The students must have the required skills and experience with modern tools to perform the necessary tasks. The computer engineering profession often involves design aspects that need to meet specific targets in terms of cost, speed, power consumption, etc. The design aspects are also often based on teamwork that demands good experience on how to work effectively within a team to maintain global competitiveness. Thus, our program aims the design abilities of students by integrating design aspects into many courses and covers system design issues that focus on the integration of hardware and system components, which is a common practice in modern computer systems design. Moreover, teamwork is encouraged throughout the

program in lab work, course projects, and senior design projects. A necessary aspect of successful engineers is their ability to communicate their ideas effectively while presenting their work or sharing information with other peers. This is one of the important outcomes addressed by our program. Preparing the students in all these aspects will give them the confidence to practice the profession of Computer engineering and be able to make contributions to it.

Objective 2: Pursue a life-long career of personal and professional growth with superior work ethics and character.

Computer engineering is a rapidly growing field. This requires engineers to continuously develop their knowledge and skills to remain up-to-date in their field and to grow in their profession. Thus, it is important to train the students on how to acquire knowledge. Therefore, the ability to engage in life-long learning is an important aspect of our program. Computer engineers often have to learn a new programming language or master the use of a new engineering tool. To enable our students to grow professionally in their career, they must be trained to practice their profession with superior work ethics and character. In addition, they need to become aware of the impact of engineering solutions in global and societal contexts and contemporary issues affecting the economy and the environment.

Objective 3: Pursue advanced study and research at the graduate level.

This objective is aligned with one of the university objectives on preparing our students for pursuing advanced study and research at the graduate level. For students to successfully pursue graduate studies, they must have the necessary foundation in mathematics, science and engineering to formulate and solve research problems. They should be skillful at using modern tools for performing the necessary experiments to evaluate proposed solutions. In addition, they must have on excellent self-learning ability to be able to review and absorb the literature. Writing skills are important for graduate students to help them write their theses and publishing their research results.

3.4. Relationship of courses in the Curriculum to the Program Outcomes

To ensure that the outcomes of the computer engineering program will be achieved by students by the end of their program of study, it is necessary that such outcomes are injected and adequately covered throughout the program curriculum. We have decided that the program outcomes should be covered by core courses in the program, because core courses are taken by all students in the program. Elective courses are not considered as they are not guaranteed to be taken by all students. However, elective courses will provide additional enhancement for the achieving the program outcomes. Each program outcome is addressed by a set of core courses in the program, thus increasing the likelihood of the outcome being achieved by the end of the program.

The learning outcomes of each core course are mapped to the Program Outcomes with a level of emphasis being either low (L), medium (M), or High (H). The level of emphasis of a program outcome is determined by the weight used for assessing the outcome in each course. For each core course, faculty members have agreed on a minimum weight that should be used in the assessment of each course outcome. This

minimum weight ensures a minimum level of coverage for an outcome in a course and is used for deciding the level of coverage for the program outcome corresponding to the course outcome.

The level of emphasis for an outcome is determined by the weight as follows:

- When the course outcome weight is < 10%, it will be given a Low rank (L).
- When the course outcome weight is between 10% and 20% it will be given a Medium rank (M).
- When the course outcome weight is ≥ 20% it will be given a High rank (H).

shows the mapping between the Course Outcomes of COE core courses and Program Outcomes. The program outcomes are covered in an overlapping manner over the COE core courses of the program curriculum. Design capabilities are adequately covered by several courses. The ability to apply knowledge of math, science and engineering to solve engineering problems are also well addressed in several courses. Teamwork is encouraged in all courses with lab work or project. The ability to design and conduct experiments is covered in courses involving lab work. The use of engineering tools is also emphasized in all courses with lab work or course projects. Students are also trained on self-learning abilities in several courses. Communication skills are emphasized in all courses with a project in addition to the seminar course, COOP and summer training. The seminar course (COE 390) is focused on enhancing the students oral presentation skills. In addition, a specialized course on technical report writing (ENGL 214) is taken by all students and focuses on enhancing their writing skills. A dedicated course (IAS 211/IAS 212) that educates students on ethical issues and professional ethics is also taken by all students. Moreover, aspects of computing ethics are covered in the seminar course (COE 390). The impact of engineering solutions on global and societal context is also addressed in the seminar course (COE 390) and in the senior design project. Knowledge of contemporary issues is also addressed in the seminar course (COE 390), the senior design project and in other courses taken by the students from the Islamic and Arabic Studies (IAS) program.

A detailed description of the course syllabi and associated course outcomes is given in Appendix A.

Table 3.4-1. Coverage of Program Outcomes.

Outcome\ Course	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**
COE 202	H		H								L			
COE 203		M	H	L			L				H			
COE 205			H	L					L		L			
COE 305	M	M	H	L	H				L		L			
COE 308	H		H		L				L		L			
COE 341	M		H		H				L		L			
COE 344	M	M			H					L	L			
COE 360	L	L	H	L			L				M			
COE 390						M	H	L	M	M				
COE 400	M	M	M	M	L	M	M	M	L	M	L			H
COE 485	L	M	H	M	L	M	M	L	L	L	M			M
COE 351	L		H	M	M	M	H	M	M	M	M			M
COE 399				M		M	H		M		H			
STAT 319												H		
ICS 252													H	
IAS 211						H								
ENGL 214							H							

Table 3.4-2 shows the mapping from the course outcomes to the POs. Appendix A provides the detailed description of each core course and associated course outcomes.

Table 3.4-2. Mapping from course outcomes to program outcomes

		a	**b**	**c**	**d**	**e**	**f**	**G**	**h**	**i**	**j**	**k**	**l**	**m**	**n**
Digital Logic Design COE 202	**O1**	**x**													
	O2			**x**											
	O3											**x**			
Digital Logic Laboratory	**O1**			**x**											
	O2											**x**			
	O3		**x**												
COE 203	**O4**				**x**										
	O5							**x**							

Computer Organization & Assembly Language COE 205	**O1**			**x**											
	O2											**x**			
	O3			**x**											
	O4									**x**					
	O5				**x**										
Microcomputer System Design COE 305	**O1**	**x**													
	O2		**x**												
	O3			**x**											
	O4				**x**										
	O5					**x**									
	O6											**x**			
	O7									**x**					
Computer Architecture COE 308	**O1**	**x**													
	O2			**x**											
	O3					**x**									
	O4											**x**			
	O5									**x**					
Data & Computer Communication COE 341	**O1**	**x**													
	O2			**x**											
	O3					**x**									
	O4											**x**			
	O5									**x**					
Computer Networks COE 344	**O1**	**x**													
	O2		**x**												
	O3					**x**									
	O4										**x**				
	O5											**x**			
Cooperative Work COE 351	**O1**	**x**													
	O2		**x**												
	O3			**x**											
	O4					**x**									
	O5						**x**								
	O6							**x**							
	O7								**x**						
	O8									**x**					
	O9										**x**				
	O10											**x**			
	O11				**x**										
	O12														**x**
Principles Of VLSI Design COE 360	**O1**	**x**													
	O2		**x**												
	O3			**x**											
	O4											**x**			
	O5				**x**										
	O6							**x**							
Seminar COE 390	**O1**										**x**				
	O2							**x**							
	O3						**x**								
	O4											**x**			
	O5									**x**					
Senior Design Project COE 485	**O1**	**x**													
	O2		**x**												
	O3			**x**											
	O4					**x**									
	O5						**x**								
	O6							**x**							
	O7								**x**						
	O8									**x**					
	O9										**x**				

	O10											**x**			
	O11				**x**										
	O12														**x**
System Design Laboratory **COE 400**	**O1**	**x**													
	O2		**x**												
	O3			**x**											
	O4					**x**									
	O5						**x**								
	O6							**x**							
	O7								**x**						
	O8									**x**					
	O9										**x**				
	O10											**x**			
	O11				**x**										
	O12														**x**

The COE faculty defined the Program Outcome Performance Indicators for each PO.

Table 3.4-3 shows the definition of the four program outcome performance indicators for outcome (c) “an ability to design a system, component, or process to meet desired needs”. The complete set of Program Outcome Performance Indicators for each PO will be shown as part of the display material.

Table 3.4-3. Program Outcome Performance Indicators: (c) an ability to design a system, component, or process to meet desired needs

Outcome	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Translate general requirements into specific system behavior and features	Requirements are translated accurately and with great precision into system behavior and features clearly described without ambiguity and without entering into any design details	Requirements are translated accurately into system behavior and features clearly described with some ambiguity. The description of behavior and features enters into some details and proposes design solutions thinking it is just translating the requirements	Requirements are not translated accurately into system behavior and features. Some features not clearly described. Some consistency errors.	Specification does not follow the requirements consistently. Several consistency errors. No clear difference between system behavior description and features and design solutions
Identify and formulate any problem that need to be addressed before being able to start designing (design feasibility)	Potential conceptual problems are addressed and properly formulated. Some system behavior is translated into some mathematical formulas describing necessary conditions for the system to function properly or alike	Potential conceptual problems are addressed but not properly formulated. Some system behavior is translated into some mathematical formulas describing necessary conditions for the system to function properly with some errors on the assumptions.	Potential conceptual problems are recognized but not properly formulated. No system behavior is translated into some mathematical formulas describing necessary conditions for the system to function properly.	Potential conceptual problems are not identified in any way.
List different design alternatives for the overall system (design feasibility)	Different design alternatives are proposed and clearly discussed and compared. The comparison is rigorous and accurate.	Different design alternatives are proposed and clearly discussed and compared. Some rigor missing in the comparison although accurate statements are made.	A small subset of the possible design alternatives is considered. No thorough comparison is performed and statements are not accurate.	No design alternatives are proposed.
Choose the appropriate design solution using technical and economic criteria	The analysis of the technical and economic constraints leads to the optimal design solution. The justification and argumentation is thorough, accurate and consistent.	The analysis of the technical and economic constraints leads to the optimal design solution. The justification and argumentation is accurate and consistent but not thorough. Missing justifications for some aspects.	The analysis of the technical and economic constraints does not lead to the optimal design solution. The justification and argumentation are a little accurate and superficial.	The design solution is presented without any analysis. Some inappropriate justification and argumentation is present with a lot of inconsistencies.

3.5. Documentation

Display Material

Following is a list of the display Material that will be available for inspection by the ABET Visit Team. The list includes folders, demos, videos, and documents displayed at the time of the visit as follows:

1. Course Files prepared by the course instructors, including:

    1. Course Instructor Report describing grading and comments on course delivery and course syllabi with declared course outcomes (all area subjects must be filled),
    2. Course Assessment Report: Student Survey on the achievement of course outcomes and instructor comments on improvement, Instructor Course Outcome Assessment data and instructor comments on improvement. For each of the above the instructor is expected to compare the score obtained to the performance criteria for the corresponding program outcome and provide (1) his own comments and (2) corrective action if the criterion is not met.
    3. Course Syllabi including catalog description (requisite), Instructor name and contacts, office time, course objectives, and course outcomes, text book, grading policy, course topics, lecture break-down per week or per chapter, and dates of exams if any.
    4. List of semester assignments, Quizes, Exams with solutions and sample of student work including (1) best, (2) average, and (3) worst performance.
    5. Course project (if any): instructor description of the project (cover-sheet), and sample (best, average, worst) of student project reports with instructor grading shown in red.
    6. Handout material (if any).
    7. For COE 400, 485 (each offered section in T082), 399, 351, 344, and 305. Each course instructor attaches the filled rubric data sheets and the Program Criterion Used for each of the addressed program outcomes. In addition the instructor provides:

        - Outcome Achievements Folder: For each outcome addressed in a course-rubric, the instructor provides a set of student reports (progress or final reports), each report has one or more pointers (Yellow Pointer) to the student work addressing a specific outcome and a note from the instructor on his rubric grading based on the **Performance Criteria** of the same outcome. Some instructor description is needed as to show the basis for his student-by-student (or project by project) rubric scoring including indication of the work quality in connection with the Performance Criteria. The pointing to attached student work or student report will make it easy to prove the “achievement” or “un-achievement” of outcomes for a given course.
        - Description of the basis for his student-by-student (or project by project) rubric scoring including indication of how (instructor

description) graded, basis for scoring (performance criteria), and where (pointing to attached student work or student report).

- One or two Working Demos (only for COE 400 "Embedded Systems" and COE 485 "Senior Design Project" (each offered section in T082)) with a set of intermediate student reports including: problem statement, problem specification (or report), progress reports, and final report. Display may also use the design with a poster and a video clip reporting its original demo together with the student final report.
- For COE 351 "COOP" the course file is to include samples of student Reports, all faculty filled rubric evaluation forms, and the performance criterion for each addressed program outcome.

2. Textbooks for each COE core or elective course with its syllabi.
3. Textbooks and course syllabi for a number of supporting courses that contribute to the rubric assessment, such as: (1) Mathematics (MATH 101, 102, 201, 260, STAT 319), (2) Physics (PHYS 101 and 102), (3) Ethics (IAS 212), (4) English Technical Writing (ENGL 214), and (5) Discrete Structures (IAS 252).
4. A separate folder for each of the following subjects:

    1. All COE Council Meeting Minutes in connection with major Accreditation issues. Please see the current display material at URL: http://faculty.kfupm.edu.sa/COE/mayez/ABET/Council-Meetings.doc

    2. Ten Graduating COE Student Transcripts: to make sure all COE program requirements are met, all required and elective courses taken, total earned credits, name of courses and their credits in transcript and in COE program, semester by semester sequencing, student performance status (good standing, probation, etc.), pre-requisite and co-requisite check for each course,

    3. The complete set of Program Outcome Performance Indicators for each PO. Please see the current display material at URL: http://faculty.kfupm.edu.sa/coe/mayez/ABET/Program-outcomes-perfromance-indicators.doc

    4. Rubrics Assessment Data for all the COE POs arranged by semester for T062, T071, T072, T081, and T082. Each set includes summary information (one page) as well as detailed Rubrics Rating description based on student-by-student evaluation in each relevant course. Please see the current display material at URL: http://faculty.kfupm.edu.sa/coe/mayez/ABET/Rubric-Assessment-Data.doc

    5. Curriculum Corrective actions (1999-2009). Please see the current display material at URL: http://faculty.kfupm.edu.sa/coe/mayez/ABET/Curriculum-Corrective-Actions.doc

6. The summary of course-based program outcome assessment for Terms 061, 062, .., 082. Please see the current display material at URL: http://faculty.kfupm.edu.sa/coe/mayez/ABET/Course-Assessment.doc

7. Minutes of the IAC meeting and discussion session for April 2009 and May 2009 meetings. Please see the current display material at URL: http://faculty.kfupm.edu.sa/coe/mayez/ABET/Analysis-IAC-Meeting.doc

8. Analysis of the Graduating Student Exit Survey. Please see the current display material at URL: http://faculty.kfupm.edu.sa/coe/mayez/ABET/Analysis-Exit-Surveys.doc

9. Set of COE program Surveys. Please see the current display material at URL: http://faculty.kfupm.edu.sa/coe/mayez/ABET/Surveys.doc

10. Alumni Surveys. Please see the current display material at URL: http://faculty.kfupm.edu.sa/coe/mayez/ABET/Alumni-surveys.doc

11. Employer Surveys. Please see the current display material at URL: http://faculty.kfupm.edu.sa/coe/mayez/ABET/Employer-surveys.doc

12. Student Transcripts. Please see the current display material at URL: http://faculty.kfupm.edu.sa/COE/mayez/ABET/Student-Transcripts.doc

Relation of Display material to each PO

The displayed material will help the ABET Visit Team examine (1) details about rubrics assessment for each program outcome and for each student, (2) details of course outcome assessment including performance of each course outcome for each course and a summary, (3) student scores in supporting courses, (4) student project demo as an example of achievement of program outcomes with student report showing how each program outcome is achieved through COE 400 and COE 484, (5) how students (exit survey) and Alumni judge their achievement of the program outcomes as well their satisfaction with their knowledge and skills, and (6) how Employers are satisfied with the achievement of program outcomes.

As presented later in this criterion, each PO is assessed by using a number of different channels (rubric, supporting courses, exit exam and exit survey). The aggregation of the assessment components for each PO is presented at the end of this Criterion.

3.6. Achievement of Program Outcomes

The assessment process helps in making effective program improvements while being efficient and maintainable. In this section we present the following aspects of the COE assessment system for the POs:

1. The assessment process
2. Description of assessment tools

3. Assessment methodology and performance criteria
4. Rating of learning in major rubrics
5. ABET and Assessment committees
6. Program assessment plan
7. Course outcomes assessment (secondary)
8. Example of PO assessment through courses
9. Feedback analysis from IAC, graduating student survey, and Alumni.
10. Level of achievement of each program outcome (Rubrics, supporting courses, exit exam and exit survey)

The Assessment Process

The PO Assessment Process is shown in Figure 3.6-1.

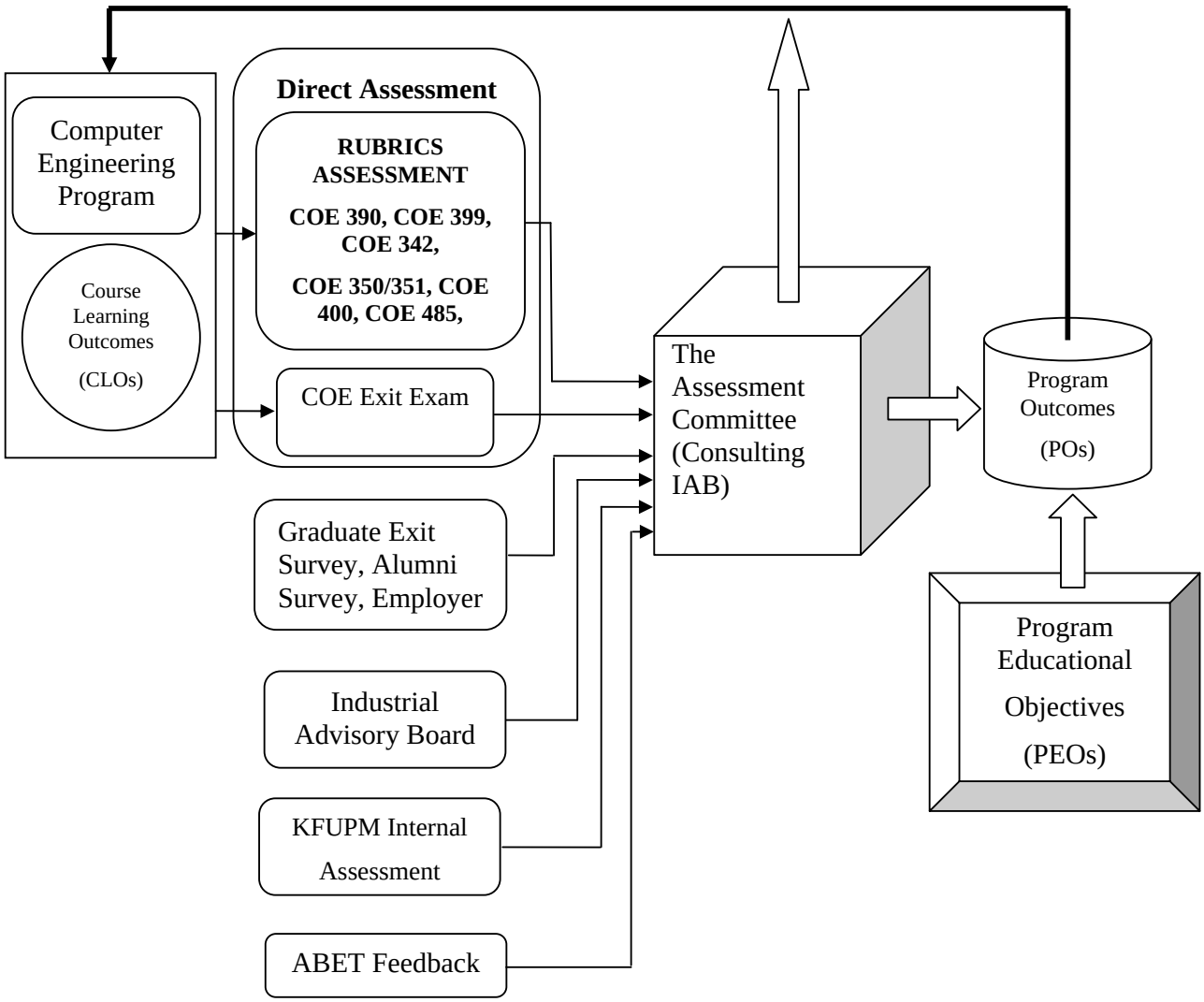


Figure 3.6-1. Program outcomes assessment process.

This process is based on the following three steps:

1. Based on the Program Outcomes, the courses serving each outcome will be determined altogether with a specific level of emphasis as described in the mapping of program courses to program outcomes. In this step, it is ensured that all program outcomes are well addressed and covered in the curriculum, mainly through the core courses of the program.
2. **Secondary Outcome Assessment Process**: A secondary outcome assessment process is based on course assessment aiming at locally (within the course) improving course outcomes by course instructors. Course outcomes are assessed both directly (exams) and indirectly (surveys) by course instructors. Each instructor reports, in the course file whether the course outcomes are

achieved or they need improvement. In case an outcome needs improvement, the course instructor provides suggestions in the course file for improving the coverage of that outcome in the next offering of the course. The course file (syllabus, course outcome assessment, action for improving, copy of student exams, etc.) is submitted to the department office at the end of each semester for each offered course. The summary of course-based program outcome assessment for Terms 061, 062, .., 082 will be presented as part of the display material.

3. **Primary Outcome Assessment Process:** The primary program outcomes assessment is independent from the course assessment (secondary) and the grading process. As program outcomes measure knowledge and skills at the time of graduation, the primary program outcome assessment is mainly based on a set of high level COE courses, a set of non-COE supporting courses (Math, Ethics, Discrete Math, English), a set of surveys, and an Exit Exam:

   - **Direct Program Outcomes Assessment**

   Rubrics Assessment: A set of Rubrics are designed to allow assessing the program outcomes based on randomly selected materials from a variety of COE courses to represent the student performance at the graduation time. Each PO is assessed using a rubric. Each rubric covers a collection of courses (Junior and Senior) that serves the POs. Randomly selected student material is considered as to represent the PO performance. Thus, each PO is assessed through more than one channel. The rubric assessment material represents a fraction of the overall course material. Each rubric is carefully analyzed and associated with a set of performance indicators which are designed to describe the outcome components both in depth and diversity. Details of rubric assessment data will be presented as part of the display material. Also a performance criteria (a threshold) is set to help determine whether a given program outcome is considered achieved or not based on a given outcome result. The ability to design experiments (Outcome b) is better assessed in COE 305 (Microprocessors) and COE 344 (Computer Networks) because these courses have a lab component with a major experimental setting. Many program outcomes are assessed using three courses which represent a culminating design experience in the program, namely COE 351 (COOP), COE 400 (Embedded Systems), and COE 485 (Senior Design Project). Outcome f is explicitly addressed in COE 390 (Seminar). The course 399 (Summer Training) contributes to the assessment of outcome g. Table 3.6-1 shows the mapping between the selected courses and the PO Rubrics.

Table 3.6-1. Mapping between selected courses and PO Rubrics.

Course	Assessed Program Outcome (Rubrics)											
	a Math	b Exp	C Des	d Team	e Form	f Ethics	g Com	h Impact	i Learn	j Cont	k Tool	n H/S
COE 305 (lab)		×										
COE 344 (lab)		×										
COE 351	×		×	×	×		×	×	×	×	×	×
COE 390						×						
COE 399							×					
COE 400	×	×	×	×	×		×	×	×	×	×	×
COE 485	×		×	×	×		×	×	×	×	×	×

- **A graduation exit Exam.**

- **Indirect Program Outcomes Assessment**

  Indirect program outcomes assessment is based on a set of well designed surveys which are: (1) the Graduate Exit Survey, (2) COOP Supervisor Survey, (3) Alumni Survey, (4) Employer Survey, and (5) consultation of the Industry Advisory Committee. All surveys are available as part of the display material. A sample COOP Supervisor Survey is shown below:

King Fahd University of Petroleum and Minerals
Computer Engineering Department

Assessment Form by COOP Supervisor

Dear COOP Supervisor:

The Department of Computer Engineering (COE) at the King Fahd University of Petroleum and Minerals employs a continuous assessment plan for its program according to the ABET engineering accreditation criterion. We are very much interested to know how our COOP students have met these criteria. Your answers will help us enhance our program and improve the quality of graduates to better serve industry.

Student Name: _____ Student KFUPM ID #.: _____

Semester: _____Academic Year:_____

I Program Outcomes

To what degree was the student expected to meet the criterion during the COOP program: 1: Low 5: High					Program Outcome Criteria		To what degree did the student **meet** the criterion during the COOP program: 1: Poor 5: Excellent				
1	**2**	**3**	**4**	**5**			**1**	**2**	**3**	**4**	**5**
					a	Apply knowledge of mathematics, science, and engineering to obtain solutions and formulate models of processes and systems.					
					b	Design and conduct experiments, and collect, analyze and interpret data.					
					c	Design a system, process, or component to meet desired needs subject to given constraints. Analyze and evaluate alternative solutions.					
					d	Function on multi-disciplinary and/or diverse teams. Take responsibility, share work, and value other viewpoints.					
					e	Identify, formulate, and solve engineering problems. Make appropriate and necessary assumptions. Suggest and evaluate new approaches.					
					f	Understand professional and ethical responsibilities. Demonstrate ethical practice.					

					g	Use oral, written, and audio-visual techniques effectively for successful communication.						
					h	Understand global effects of practices, products, and events, and the impact of engineering solutions on society						
					i	Recognize the need for and demonstrate ability to engage in lifelong learning.						
					j	Know about contemporary socio-economic issues relevant to relevance to computer engineering.						
					k	Use techniques, skills and modern engineering tools necessary for engineering practice.						
					l	Know probability and statistics and their applications in Computer Engineering.						
					m	Know discrete mathematic: e.g. Logic, Number theory, Set theory, Algorithms, Information theory.						
					n	Design a system that involves the integration of hardware and software						

II Comments

A Other skills required by your organization

_____

_____

_____

B How do you compare KFUPM-COE COOP students with those of other universities

_____

_____

_____

C Currently KFUPM-COE Program Educational Objectives aim at producing computer engineering graduates who are prepared to:

1. Practice their profession with confidence and global competitiveness and make intellectual contributions to it;
2. Pursue a life-long career of personal and professional growth with superior work ethics and character, and
3. Pursue advanced study and research at the graduate level.

Strengths you see in the KFUPM-COE program and its educational objectives

Other educational objectives that you believe should be added

III Contact Information

Information on the person who completed this form:

Name:	
Position / Title	
Department, Company	
e-mail:	
Date:	

More details will be given in the next sub-section on the Program Outcomes Assessment Method which is used to determine under what conditions a given program outcome can be considered as met or not.

Description of Assessment Tools

Before we describe the assessment and evaluation plan for program outcomes, we briefly review the methods used for the assessment of program outcomes:

1. **Computer Engineering Exit Exam*:*** The computer engineering exit exam is designed based on the core Computer engineering courses in which all the program outcomes are covered. This includes the courses: COE 202, COE 205, COE 305, COE 308, COE 341, COE 344, COE 360, and COE 400. The exam characteristics are as follows:

    - 60 questions (multiple choice format) in total
    - Two hours exam setting
    - Each question should take an average of 2 minutes to answer
    - Each question should map into one of the outcomes (a through n) covered by the course.

    The COE exit exam focuses on fundamentals and provides a good feedback in identifying some areas of improvements in the program. Specifically, the exit exam addresses the program outcomes (a), (c), (e), (k), (l), and (n). The COE exit exam is conducted every semester.

2. **Seminar Course (COE 390):** This course is used in the program outcomes assessment as it addresses some program outcomes with greater emphasis compared to other courses. In this course, effective presentation skills are covered and students are given the chance to give two presentations. In the first presentation, students will be coached on the areas that need improvement and will receive feedback from both the instructor and other students based on the use of oral presentation assessment rubric. The second presentation has a high weight in the course and the presentations skills of the students will be assessed to determine their ability in achieving this outcome. The first presentation is based on a topic related to computing ethics and the second is based on a technical computer engineering topic. Professional code of ethics and computing ethics issues are also covered in this course. In addition, aspects related to contemporary issues and the impact of engineering solutions in a global and societal context are addressed in the course through presentation by invited speakers. Students are asked to assess the achievement of the course outcomes at the end of the semester and these results are used as part of the assessment of related program outcomes.

3. **Embedded Systems (COE 400):** The purpose of this course is to integrate student's knowledge of hardware and software in the design, implementation, debugging, and documentation of a major system. The twin learning experience of making hardware versus software decisions, and participating in a structured design are integrated into the same design exercise.
   This course is taken by all computer engineering students at the senior level and covers many of the program outcomes. Samples of students reports collected every semester are used to assess the covered outcomes using proper assessment rubrics.

4. **Senior Design Project (COE 485)*:*** The purpose of this course is to integrate students' knowledge of hardware and software in the design. This course is designed to give students the experience of tackling a realistic engineering problem. The intent is to show how to put theoretical knowledge gained into practical use by starting from a word description of a problem and proceeding through various design phases to end up with a practical engineering solution. Various projects are offered by COE faculty in their respective specialization areas. The project advisor guides the student in conducting a feasibility study, preparing specifications, and adapting design methodology. Detailed design and implementation of the project are carried out followed by testing, debugging, and documentation. An oral presentation and a final report are required at the end of the semester.
   All computer engineering students in the non-COOP program option take this course. It covers many of the program outcomes and provides a good assessment tool for measuring the achievement of those outcomes. Sample reports and presentations made by the students are collected and evaluated using proper rubrics.

5. **Cooperative Work (COE 350/351*):*** This course is taken by all computer engineering students in the COOP program. It is based on a continuous period of 28 weeks spent in industry with the purpose of acquiring practical experience in various areas of computer engineering. During these activities, a faculty member and a company supervisor supervise the students. During this period, the student is exposed to the profession of computer engineering by working in the field. Students are required to submit a final report and give a presentation about their experience and the knowledge gained during their Cooperative work. Sample of COOP reports and presentations are collected every semester and evaluated using appropriate rubrics. Company supervisors are asked to evaluate the performance of the students during these activities. Industry supervisors of COOP students are also surveyed regarding the achievements of the POs.

6. **Summer Training (COE 399):** The aim of the summer training program in industry is to provide students with direct on-the-job experience working with professionals in the field. This training provides an opportunity to expose students to the reality of professional practice. Students are required to submit a report and make a presentation on their summer training experience and the knowledge gained. The summer Training coordinator assigns faculty for

attending student presentations and for grading their summer training report. The faculty carries out the rubrics assessment based on student presentation, training report, and COOP supervisor evaluation sheet. The rubric data contributes together with other rubric assessment data toward the assessment of some program outcomes.

7. **Graduate Exit Survey:** The graduate exit survey is conducted every semester. The survey asks Computer Engineering graduates to assess their ability in achieving each of the program outcomes and provide feedback on which outcome they think needs improvement and greater emphasis in the program.

8. **Employer and Alumni Survey:** Employers of COE graduates are surveyed once every three years as part of the indirect assessment process of the program educational objectives and program outcomes achievement. Employer surveys are sent to companies who hire our COE graduates. A similar process is adapted for surveying the COE Alumni.

9. **Industrial Advisory Committee (IAC):** The industrial advisory committee consists of members from industrial organizations, which hire a good percentage of our graduates. The IAC members are asked to provide their input on the program learning outcomes. They are also asked to provide feedback on the achievement of program outcomes by our graduates and on which outcomes need to be improved through the program. Whenever possible, they will also be asked to evaluate some of students' work, especially the senior design project and Cooperative work, through which many of the program outcomes can be assessed. Two meetings (2007 and 2009) were arranged with IAC. Minutes of the IAC meetings and discussion sessions will be part of the display material. Starting from 2009, a meeting with the IAC is be arranged once a year.

Assessment Methodology and Performance Criteria

In this section we describe how each program outcome is assessed. For each program outcome, an assessment and evaluation plan is developed that consists of the following elements:

1. ***Assessment and Evaluation Methods:*** This describes what assessment methods are used to collect data and how the data is evaluated and interpreted.

2. ***Performance Criteria:*** This determines the criteria used to indicate whether an outcome has been achieved with satisfactory levels or it needs improvement.

3. ***Logistics:*** This indicates when the data is collected and who will collect it, interpret it, and report the results.

The assessment and evaluation plan for the program outcomes is shown in Table 3.6-2. For each program outcome, the assessment and evaluation methods are given. Scoring rubrics designed by the undergraduate committee are used for the assessment of the outcomes. For each assessment method, the used performance criteria enables determining when an outcome is considered achieved. Finally, the frequency of assessment of each program outcome is also indicated.

The assessment committee carries out the assessment process and collects all the needed data. The undergraduate committee uses the designed rubrics to evaluate the outcomes and determine whether they are met or not. Then generates a summary of the assessment process, which is presented to all faculty members in the department with recommendations for improvement. Once recommendations for improvement are approved by the department council, necessary changes will be implemented.

Table 3.6-2 shows for each program outcome, the assessment plan or source courses from where rubrics and other tools are drawn for the outcome assessment, the performance target as a measurable statement identifying the performance required to meet the outcome, and the logistic used to carry out the assessment. This cycle repeats at the end of each semester. Note that some evaluation forms are designed for a score out of 4 and others use a score out of 5.

Table 3.6-2. Program outcomes assessment and evaluation methods, performance target, and logistics.

Program Outcome	**Assessment & Evaluation Methods**	**Performance Target**	**Logistics**
(a) an ability to apply knowledge of mathematics, science, and engineering	• Rubric assess. through COE 400, COE 485 and COE 351 • Math 101, Math 102, Math 201, Math 260, Phys. 101, Phys. 102 • Graduate Exit Survey • COOP Employer Survey • Exit Exam	• A score ≥ 2.5 out of 4 • Average GPA ≥ 2.5 out of 4 • A score ≥ 3 out of 5 • A score ≥ 3 out of 5 • A score ≥ 2.5 out of 4	Assessments will be conducted according to the assessment plan. In addition, grades of Math, Phys. & Chem. Courses will be collected and analyzed.
(b) an ability to design and conduct experiments, as well as to analyze and interpret data	• Rubric assess. through COE 400, COE 344 and COE 305 • Graduate Exit Survey • COOP Employer Survey	• A score ≥ 2.5 out of 4 • A score ≥ 3 out of 5 • A score ≥ 3 out of 5	Assessments will be conducted according to the assessment plan.
(c) an ability to design a system, component, or process to meet desired needs	• Rubric assess. through COE 400, COE 485 and COE 351 • Graduate Exit Survey • COOP Employer Survey • Exit Exam	• A score ≥ 2.5 out of 4 • A score ≥ 3 out of 5 • A score ≥ 3 out of 5 • A score ≥ 2.5 out of 4	Assessments will be conducted according to the assessment plan.
(d) an ability to function on multi-disciplinary teams ***(d-I: Evaluation by peers, d-II: Evaluation by instructors)***	• Rubric assess. through COE 400, COE 485 and COE 351 • Graduate Exit Survey • COOP Employer Survey	• A score ≥ 2.5 out of 4 • A score ≥ 3 out of 5 • A score ≥ 3 out of 5	Assessments will be conducted according to the assessment plan.
(e) an ability to identify, formulate, and solve	• Rubric assess. through COE 400, COE 485 and COE 351	• A score ≥ 2.5 out of 4	Assessments will be conducted according to the assessment plan.

engineering problems	• Graduate Exit Survey • COOP Employer Survey • Exit Exam	• A score ≥ 3 out of 5 • A score ≥ 3 out of 4 • A score ≥ 2.5 out of 4	
(f) an understanding of professional and ethical responsibility	• Rubric assess. through COE 390 • Av. Grade in IAS 211/212 • Graduate Exit Survey • COOP Employer Survey	• Average GPA ≥ 2.5 out of 4 • A score ≥ 2.5 out of 4 • A score ≥ 3 out of 5 • A score ≥ 3 out of 5	Assessments will be conducted according to the assessment plan. Grades for IAS 212 will collected and analyzed.
(g) an ability to communicate effectively (g-O: Oral Comm., g-W: Writing Comm.)	• Rubrics Assess. Through COE 400, COE 485, COE 399 and COE 351 • Av. score in ENGL 214 • Exit Survey • COOP Employer survey	• A score ≥ 2.5 out of 4 • A score ≥ 2.5 out of 4 • A score ≥ 3 out of 5 • A score ≥ 3 out of 5	Assessments will be conducted according to the assessment plan except for COE 399 which will be assessed in a yearly basis. Grades for ENGL 214 will be collected and analyzed.
(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context	• Rubric Assess. through COE 400, COE 485 and COE 351 • Graduate Exit Survey • COOP Employer Survey	• A score ≥ 2.5 out of 4 • A score ≥ 3 out of 5 • A score ≥ 3 out of 5	Assessments will be conducted according to the assessment plan.
(i) a recognition of the need for, and an ability to engage in life-long learning	• Rubrics Assess. through COE 400, COE 485 and COE 351 • Graduate Exit Survey • COOP Employer Survey	• A score ≥ 2.5 out of 4 • A score ≥ 3 out of 5 • A score ≥ 3 out of 5	Assessments will be conducted according to the assessment plan.
(j) knowledge of contemporary issues	• Rubrics Assess. through COE 400, COE 485 and COE 351 • Graduate Exit Survey • COOP Employer Survey	• A score ≥ 2.5 out of 4 • A score ≥ 3 out of 5 • A score ≥ 3 out of 5	Assessments will be conducted according to the assessment plan.
(k) an ability to use	• Rubrics Assess. through COE	• A score ≥ 2.5 out of 4	Assessments will be

the techniques, skills, and modern engineering tools necessary for engineering practice.	400, COE 485 and COE 351 • Graduate Exit Survey • COOP Employer Survey • Exit Exam	• A score ≥ 3 out of 5 • A score ≥ 3 out of 5 • A score ≥ 2.5 out of 4	conducted according to the assessment plan.
(l) Knowledge of Probability and Statistics and their applications in Computer Engineering	• STAT 319 • Graduate Exit Survey • COOP Employer Survey • Exit Exam	• Average GPA ≥ 2.5 out of 4 • A score ≥ 3 out of 5 • A score ≥ 3 out of 5 • A score ≥ 2.5 out of 4	Assessments will be conducted according to the assessment plan except for STAT319 which will be assessed.
(m) Knowledge of Discrete Mathematics	• Av. score from ICS 251/252 • Graduate Exit Survey • COOP Employer Survey	• Average GPA ≥ 2.5 out of 4 • A score ≥ 3 out of 5 • A score ≥ 3 out of 5	Assessments will be conducted according to the assessment plan except for ICS251 which will be assessed.
(n) The ability to design a system that involves the integration of hardware and software components	• Rubrics Assess. through COE 400, COE 485 and COE 351 • Graduate Exit Survey • COOP Employer Survey • Exit Exam	• A score ≥ 2.5 out of 4 • A score ≥ 3 out of 5 • A score ≥ 3 out of 5 • A score ≥ 2.5 out of 4	Assessments will be conducted according to the assessment plan.

The details of the performance indicators for each program outcome will be presented as part of the display material. These indicators are used by the faculty for rating the student learning in the rubric assessment.

Rating of Learning in Major Rubrics Courses

The objective of this sub-section is to describe how actual learning by students is judged in the courses used in the rubric assessment. The basis for rating the learning achieved using direct measures is presented. For each rubric (program outcome) the rating culminates into determining the level of achievement of the corresponding program outcome. Support to the above course learning and its rating is presented in

the next sub-section in form of student-by-student performance tables within the rubric assessment.

The rubric-based assessment uses three COE courses for assessing most of the technical program outcomes. These courses are: (1) the Digital Systems Design (COE 400), (2) the Senior Design Project (COE 485), and to some lesser degree (3) the Cooperative Work (COE 350/351). Course organization is summarized as follows:

1. The Embedded Systems (COE 400)

   This course is a project-oriented embedded systems course. The project takes over 70 % of the time and effort in this course. At the beginning of the semester, few weeks are taken to teach the students the theoretical background of embedded systems development. During this period, basics of embedded systems are introduced followed by more detailed hardware and software related material. Hands-on experience is taught during lab sessions. In the lab sessions, students are asked to reproduce known experiments then modify the experiments in order to achieve new goals and features. The project is introduced slowly through few brainstorming sessions where students propose ideas for projects. Following numerous discussions, one project is selected through voting. The selected project must require enough work and diversity of aspects to be distributed among all the students in the course. Students are individually asked to translate business-level requirements, provided by the instructor, into technical specifications. Following a discussion session then unifies the various ideas expressed into the specification and produces a single specification report. Students are then divided into groups where every group is responsible for one aspect/part of the project. Students are taught that decision making is performed through consensus among the members of the group and in consultation and coordination with other groups when necessary. The instructor acts as a technical advisor/expert for any group. After several weeks of work, the different groups are required to produce a design report in which they describe the various aspects of the part of the project assigned to them. The implementation phase then starts in earnest. At the end of the semester, a combined final report is produced by all the groups as a collective effort.

2. The Senior Design Project COE 485

   The course is organized as follows:

   a. Although there is one regular weekly class, office hours and appointments are utilized by students to obtain all necessary information and guidance towards meeting project objectives.

   b. Email and WebCT are the main form of communication outside the classroom as required by the project progress.

   c. The Internet (company websites, newsgroups, forums, etc.) and the KFUPM library are the main source for information regarding the

proposed projects. Bookstores are also a good source for books unavailable at KFUPM.

d. Projects are student-driven; the instructor will provide description of the final outcome and set guidelines for the development process. Students are responsible for carrying out the intended tasks. The projects require excellent programming skills as well as hardware interfacing in addition to self motivation and persistence.

e. Students are required to read the rubrics (design, teamwork, and lifelong learning) and pay attention to the following:

    i. They should understand the objective of the project and identify and formulate the problem in their project before they start the designing phase.

    ii. They should list different solutions or design alternatives and choose the appropriate solution using technical and economic evaluation methods.

    iii. After selecting the best solution (design), they should break down the design into tasks and steps to achieve their goal and identify the role of each one student in the group.

    iv. During the course of the senior project, students alternate in assuming the role of the team leader to test their ability to function as a team leader and a team member.

    v. During the course of designing and implementing their projects the instructor tests their behavior in dealing with these challenges, how they make decisions, and check their level of independency.

    vi. A demonstration of their work is required at the end of the project as well as the submission of a technical report.

f. Work will be carried out by teams (3 or 4 students per team) – all members of a team should contribute equally to the project

g. Although cooperation amongst all students is encouraged, teams must work independently. Deliverables (designs, background material, code, report, etc.) submitted by different teams that are similar will receive an F grade.

h. It is prohibited to copy or paste text, figures, diagrams, or plots from other sources (books, articles, etc.) in the progress/final report or presentations without referencing the original source. Student may refer once to figures, diagrams, or plots that appear in other sources, then student should include clear reference to the source in the caption. An ‘F’ grade will be given to students who do not adhere to the above rule.

For COE 400 the Rubrics Rating of Student Learning is based on the Student Design Report which includes problem definition, analysis of alternate solutions, selection of solutions, implementation, debugging, testing, and documenting the project. It also includes work habits and team work aspects and many other soft aspects.

For COE 485 the Rubrics Rating of Student Learning is based on the following components: (1) the Project Implementation, (2) Work Habits, (3) Project Documentation and Final Report, and (3) Final Presentation. These various components are detailed as follows:

1. Project Implementation

    - Engineering approach: Specification, System design, critical examination of different approaches and justification for the selected approach(s), and utilization of basic engineering science in the design.
    - Completion of the design and the demonstration.
    - Design verification and testing: Simulations, modeling, emulation, prototyping (where appropriate) and testing.

2. Work Habits

    - Interview with the student to evaluate his involvement in the project
    - Peer evaluation where each group member evaluates every other member in the group
    - Motivation, organization, self-reliance, planning, and critical thinking.

3. Project Documentation and Final Report

    - Compliance with the report writing guidelines
    - Clarity of the problem description and proposed solution
    - System design, approach selection and design segmentation
    - Implementation/Testing report and any product manuals required

4. Final Presentation

    - Clarity of stated problem and solution
    - Quality of presentation (organization, body language …etc)
    - Discussion (how the student answers the questions which demonstrate his understanding of the project and its socio-economical aspects)

ABET Committee

The COE department has a standing ABET Committee which is responsible for the review and possible revision of the PEOs and POs whenever needed, in addition to supervising the direct and indirect outcome assessment processes, data collection and presentation, assessment data for continuous program improvement. In the following we highlight the main three tasks:

1. **Coordinate the Departmental Assessment Process and Carry out Data Analysis.** This consists of supervising, coordinating and collecting results of various assessment tools as described above. The committee has the primary responsibility for monitoring the success of the COE program in meeting its stated objectives. Compiles all assessment data at the end of each academic year, the committee analyzes the assessment data for the year and reports its findings to the department council. This is determined by comparing the outcome performance criteria to its current score if needed. Based on assessment results, the committee may identify weaknesses and suggest remedial actions for approved items by the department council.

2. **Coordinate the review process of the PEOs and POs.** The review cycle of the PEO is currently three years. The COE department chair initiates the program objectives review process according to the COE Assessment Plan. The Alumni and Employer assessment are used to the review the PEOs. The analysis and findings are presented to the departmental council to involve department faculty in the necessary changes or revision of the PEOs. Furthermore, the decision for revising the PEOs is presented to the Industry Advisory Committee for further discussion and approval. In case the PEOs are revised, the committee coordinates the process of revising the POs and consequently the course outcomes in accordance with the POs and PEOs.

3. **Coordinate the Continuous Improvement Process**. In order to close the loop for the self-assessment of the program, the committee analyze all of the collected assessment data involving direct and indirect assessment tools and identifies program outcomes that do not meet their performance criteria. Such program outcomes become the subject to possible improvements. Based on assessment results, the committee may suggest remedial actions for approved by the department council. AC set up a plan and a schedule to coordinate the continuous improvement process. A one-page report is written for each weak program outcome to be improved. The report presents some background information on the specific program outcome to be improved, such as the performance criteria, assessment tools, data collection cycle, evaluation of results, and the list of proposed actions to improve the performance of the learning outcome. The committee recommends to the department assigning a Faculty to carry out the program remedial actions based on the above continuous improvement

report for a given program outcome. Furthermore, the committee monitors the assessment data of program outcomes for which some continuous improvement actions were conducted and may possibly repeat the above process. The COE Department will maintain records of all course files, assessment reports, and refinements adopted in the undergraduate program.

Program Assessment Plan

The review process of the PEOs and POs is once every three years as indicated shown in Table 3.6-3. The planning of the Indirect Assessment and Meeting/Consulting with the Industry Advisory Committee is shown in Table 3.6-4. Planning of the Continuous Improvement and Program Assessment process is shown in Table 3.6-5.

The COE Assessment cycle is 3 years (see Table 3.6-3):

- First year: a sub-set of program outcomes is examined for possible improvement. If needed some action is taken to improve POs that need improvement. The committee documents its analysis and actions.
- Second year: the remaining subset of program outcomes is examined for possible improvement. If needed some action is taken to improve POs. The committee documents its analysis and the remedial actions.
- Third year: Data collection is carried out for all outcomes. The results of continuous improvement are analyzed. The committee documents assessment data analysis and conclusions.

Table 3.6-3. Planning the review process of the PEOs and PO

Planning of the PEOs and POs Review Process and Frequency	**2006-2007 (T061-062)**	**2007-2008 (T071-072)**	**2008-2009 (T081-082)**	**2009-2010 (T091-092)**
Review of the Program Educational Objectives PEOs (every 3 years)	X			X (Based on Surveys Data Collected in T081 and T082)
Review of the Program Outcomes (every 3 years)	X			X

Table 3.6-4. Planning the Indirect Assessment & Consulting the Industry Advisory Committee

Planning the POs Indirect Assessment	**T081**	**T082**	**T091**	**T092**	**T101**	**T102**	**T111**	**T112**
Survey of Alumni and Employers (every 3 years)	**X**	**X**					**X**	**X**
Survey of COE Graduates and COOP Supervisors (every semester)	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Meeting and consulting with the Industry Advisory Committee (every year)		**X**		**X**		**X**	**X**	**X**

Table 3.6-5. Planning the Continuous Improvement and Program Assessment processes.

Planning Continuous Improvement and Program Assessment	**T081**	**T082**	**T091**	**T092**	**T101**	**T102**
Continuous Improvement Performance Analysis of some outcomes based on Direct and Indirect Assessment Data. C(design), E(formulation), D(teamwork), G(communication), J(contemporary), L(statistics), and N(integration).	**X**		**X**			
Continuous Improvement Performance Analysis of some outcomes based on Direct and Indirect		**X**		**X**		

Assessment Data. A(math/science), B(experiments), F(ethics), H(eng. sol.), I(learning), K(tools), and M(dis. math).						
Program Assessment (Direct Assessment: Rubrics and Exit Exam)					**X**	**X**

Course Outcomes Assessment (secondary)

For each course in the Computer Engineering major, faculty involved in teaching the course have prepared a **Course Learning Outcomes Table** that includes the following for each outcome:

- Outcome indicators and details: this describes the main course topics that contribute to achieving the outcome.
- Suggested assessment methods and metrics.
- Outcome minimum weight: this indicates the importance of the outcome in the course. It is the minimum weight from the total course score (out of 100) that must be used for assessing the outcome or covering the outcome in the course.
- A mapping between the course learning outcome and ABET program outcomes.
- Each outcome is given a level of emphasis as **Low, High, Medium** that correlates with the weight used for assessing the outcome. This weight will be used in the final mapping table between courses and ABET program outcomes.
    - When the course outcome weight is < 10%, it will be given a Low rank (L).
    - When the course outcome weight is between 10% and 20% it will be given a Medium rank (M).
    - When the course outcome weight is ≥ 20% it will be given a High rank (H).

The tables for the course learning outcomes for all core Computer engineering courses are given in Appendix A.

Course outcomes are assessed every semester by course instructors both directly and indirectly. To report the direct assessment of course learning outcomes, instructor use the **Course Learning Outcomes Evaluation Table** that includes the following for each outcome:

- **Outcome minimum weight**: this indicates the importance of the outcome in the course. It is the minimum weight from the total course score (out of 100) that must be used for assessing the outcome or covering the outcome in the course.
- **Outcome weight**: this is to be filled by the instructor indicating how much weight was actually used by the instructor for assessing the outcome.

- **Assessment Method**: this describes the methods were used to asses the outcome, the weight of each method, and the evidence of assessment.
- **Class Average:** indicates the student average performance in the outcome.

It should be noted that the evaluation criteria for each outcome is flexible and can vary from instructor to instructor. However, it should be constrained with the minimum weight specified. An example of course learning outcomes evaluation table is given in Table 3.6-6.

Table 3.6-6. Example of course learning outcomes evaluation (by Faculty).

COE 205 Computer Organization and Assembly Language Programming

Outcome	Outcome Min. Weight	Assessment Method								
		Assignments	**Quizzes**	**Exam I**	**Exam II**	**Exam III**	**Final Exam**	**Lab Work**	**Project**	**Total**
O1	**55%**	**15%**	**8%**	**15%**	**20%**			**5%**	**8%**	**71%**
	Average	12.1%	5.3%	9.5%	12.1%			4.1%	7%	50.1% (70.6%)
	Evidence	#1-4	#1-4, 6	Q1-5	Q1-5			#1-13	Report	
O2	**4%**							**5%**		**5%**
	Average							4.1%		4.1% (82%)
	Evidenc							#1-13		
O3	**15%**						**20%**			**20%**
	Average						11.8%			11.8% (59%)
	Evidenc						Q1-5			
O4	**2%**		**2%**							**2%**
	Average		1.3%							1.3% (65%)
	Evidenc		#5							
O5	**2%**								**2%**	**2%**
	Average								1%	1% (50%)
	Evidenc								Report	
Weight		**15%**	**10%**	**15%**	**20%**		**20%**	**10%**	**10%**	**100%**
Average		**12.1%**	**6.6%**	**9.5%**	**12.1%**		**11.8%**	**8.2%**	**8%**	**68.3%**

Class average for an outcome is computed by adding the average weights obtained from each assessment method used for the outcome divided by the total outcome weight. For example:

Class Average of Outcome 1 = [Assignments (12.1) + Quizzes (5.3) + Exam I (9.5) + Exam II (12.1) + Lab Work (4.1) + Project (7)] / 71 * 100 = 50.1/71*100 = 70.6.

Faculty may use the proposed outcome evaluation table or other methods to report the assessment of course learning outcomes. The important component in the direct assessment process is that each faculty must address the following important points for each outcome:

- Whether a course outcome is considered achieved with satisfactory level or not and provide justifications.
- If an outcome needs improvement, suggest possible actions for improvement in the next offering of the course.

Course outcomes are also assessed indirectly through the use of a student questionnaire in the last week of the semester. In this questionnaire, students are asked to evaluate their course outcome achievement in the course. An example of indirect outcome assessment form is given in Table 3.6-7. The achievement of each course outcome is rated as either: Excellent (E), Good (G), Average (A), or Poor (P). A composite value is computed for each outcome out of 4. If the composite value of any outcome is < **2.5**, the instructor needs to comment on this and suggest corrective actions for improvement.

Table 3.6-7. Course learning outcomes indirect assessment (Student Survey)
(Outcomes are identical to those of Table 3.6-2)

COE 205 - Computer Organization & Assembly Language Course Outcomes Assessment						
Instructor:			**Term:**			
	Student Evaluation					
Criteria	**E (4)**	**G (3)**	**A (2)**	**P (1)**	**NA (0)**	**Composite**
1. As a result of this course, my ability to analyze, design, implement, and test assembly language programs can be described as,	11	6	2			3.47
2. As a result of this course, my ability to use tools and skills in analyzing and debugging assembly language programs can be described as,	6	10	3			3.16
3. As a result of this course, my ability to design the datapath and control unit of a simple CPU can be described as,	8	8	1	1	1	3.11
4. As a result of this course, my ability to demonstrate self-learning capability can be described as,	9	7	2	1		3.26
5. As a result of this course, my ability to work in a team can be described as,	8	7	4			3.21
	Number of Responses: 19					

The Undergraduate committee will review and evaluate the course assessment results every semester within the first two weeks of the beginning of a semester. Then, a report will be generated summarizing the findings and suggesting recommendations for addressing outcomes who achievement found need improvement to the department. The findings and suggested recommendations will be sent to all faculty members and discussions will be held in a department council. Once recommendations are approved, they are implemented by concerned faculty in related courses.

Example of PO assessment through courses

Information was collected from course files in the 2007-2208 academic year on the scores achieved for each of the course outcomes pertaining to eleven core COE courses, as well as observations and recommendations by the course instructors. The scores were derived separately from direct assessment by the instructor throughout the semester and indirect assessment by the student survey completed by the students towards the end of each semester. Overall assessment for each outcome was indicated as “Achieved” or “Needs Improvement”. Considering two successive semesters,

Table 3.6-8 and Table 3.6-9 summarize the evaluation achievement status for the eleven courses, respectively.

Table 3.6-8. Summary of overall achievement status for course outcomes for eleven core courses for Term 062.

Course	**Summary of the core course outcomes for Term 062**													
	A	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**
COE 202	•		o								o			
COE 203		o	•	•			•				•			
COE 205			•	•					•		•			
COE 305	•	•	•	•	o				o		•			
COE 308	•		•		o				•		•			
COE 341	o		•		o				•		•			
COE 344	•	•			•					o	•			
COE 360	•	•	o	•			•				o			
COE 390						•	•	•	•	•				
COE 400	•	•		•	o		•		•		o			•
COE 485	•	•	•	o	•	•	•	o	•	•	•			

Table 3.6-9. Summary of overall achievement status for course outcomes for eleven core courses for Term 071.

Course	Summary of the core course outcomes for Term 071													
	A	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**
COE 202	•		o								o			
COE 203		•	•	•			•				•			
COE 205			o	•					•		•			
COE 305	•	•	•	•	•				•		•			
COE 308	•		•		•				•		o			
COE 341	o		•		•				•		•			
COE 344	o	•			o					•	•			
COE 360	•	•	o	•			•				•			
COE 390						•	•	•	•	•				
COE 400	•	•		•	•		•		•		o			•
COE 485	•	•	•	•	•	•	•	o	•	•	•			

• = Outcome is achieved as judged by the instructors of all sections.

o = Outcome achievement needs improvement as judged by the instructor of at least one section.

The summary of course-based program outcome assessment for Terms 061, 062, .., 082 will be presented as part of the display material.

Comments from the Industry Advisory Committee on the Program Outcomes

Two meetings were held for the COE Industry Advisory Committee. The first and second meetings were held on April 25, 2007, and May 31, 2009 at the COE department. The Dean of CCSE, chairmen of SE and ICS department were also invited. The meeting was also attended by all COE faculty and by students representative as the president and vice president of the CCSE Computer Club.

Minutes of the IAC meeting and discussion session for April 2009 and May 2009 meetings is presented as part of the display material. The minutes provide details about the comments raised by the IAC members. Following is a list of the comments formulated by the IAC members regarding the POs and how these comments were addressed. The IAC inputs on the Program Outcomes are:

a. Program outcomes are fine and the only suggested improvement is to stress more practical disciplines. This saves time when engineers join work and become productive at work. This in our opinion is more beneficial for our needs than having engineers with broad knowledge at the expense of having specific practical ability and one or two specialties. In other words, we feel that they should specialize and go in depth in specific disciplines that will make them productive faster.

b. Program outcomes need some improvements, since we are now competing in global level, not local level. Companies now look for skilled employees regardless of their physical location.
c. Students graduating from KFUPM are very good especially in work ethics. However, they lack specialization. Although they have basic knowledge in designing networks, developing software codes for embedded systems, they lack in depth focus. It will be better if the last 2 semesters at minimum, are dedicated to specialization for the benefit of both the student and the organization that will employ them.

The COE program addressed these comments as follows:

a. The COE program curriculum has been revised to introduce three elective courses to provide more in-depth specialization in the areas of Computer Networks and Communication and Computer Applications. Other courses are currently proposed in the area of High-Performance Computing. These new courses are Computer System Performance COE 402, Internetwork Design and Management COE 444, Mobile Computing COE 446, Network Security Engineering COE 449, Data Management COE 499, Introduction to Robotics COE 484, Parallel Computing COE 420, and Advanced Microprocessor Systems COE 403. Some of these courses are becoming popular with the students.
b. Adopting the ABET 2008 Criterion as the quality Assurance system for the COE program. we believe that will provide us, over the long term, a global appreciation of engineering in the program. Our graduates will gain global competitiveness in the practice of their profession.
c. Moreover, the COE 400 "Embedded Systems" and the COE 485 "Senior Design Project" have been revised together so that they provide a framework where engineering design experience culminates in major student project. For this reason we used the above courses as the main components in the rubric-based assessment of program outcomes.

Level of Achievement of Each Program Outcome

The process of carrying out direct and indirect assessment started in 2007 and took two years before maturing to an acceptable level. Using the collected direct and indirect assessment data the COE ABET Committee started analyzing the level of achievement of each program outcome in the academic year 2008-2009. The committee used the POs achievement data as the basis for improving some POs in each semester according to the COE Assessment Plan. In T081, the COE ABET committee started the process carrying out the continuous improvement in the COE Program.

As described before in Table 3.6-2 the POs assessment process uses multiple channels for assessing each PO. These channels are:

1. The Exit Exam which covers all core program courses.

2. The average score in the following supporting courses: (1) MATH 101, 102, and PHYS 102 (outcome a), (2) IAS 212 (outcome f), (3) ENGL 214 (outcome g), (4) STAT 315 (outcome l), and (5) ICS 251/252 (outcome m). The average score is evaluated for the students which are considered in the Rubric Assessment for each term.
3. The Exit Survey.
4. The COOP Supervisor Survey (started in Term T082).
5. The Rubric scores for a set of selected core junior and senior courses. The program defined the rubric assessment tools for each PO which was described in Table 3.6-1. These courses were selected because they represent a culminating experience platform where students integrate their knowledge and skills in a major design experience. With these courses taken close to graduation, they provide an adequate measure of PO achievements at the time of graduation.

Following is an outline of the status of each of the above PO assessment tools prior to the integration of all assessment scores into one assessment table that summaries the scores from various assessment channels to help determine the level of achievement of the POs.

Exit Exam

The exit exam contributes with other assessment tools in assessing the COE program outcomes (a), (c), (e), and (k). In 2007-2008 the COE faculty developed a large set of questions covering the COE 202, COE 205, COE 305, COE 308, COE 341, and COE 360 courses. The first Exit Exam targeted a 2-hour duration and was implemented as part of the student clearance process, e.g. just before the student graduates from the COE program. In term T081, 30 senior students attempted the exam. The average score of the exam was 24.9 out of 60 i.e. 41.5% which is surprisingly low. The COE faculty analyzed the results and observed that the students did not take the exam seriously as most questions were attempted by only a few number of students. Lack of incentives for the students to do their best in the exam was considered a major issue. The students tried to finish the exam as soon as possible without spending enough time for understanding the questions and making proper selection of the right answer. For these reasons the ABET committee considered that the score does not represent the real student achievement level for the program outcomes. To resolve the above issues, the ABET committee suggested the following:

1. Students who successfully pass the Exit Exam should be awarded certificates by the department testifying that they have passed the COE exit exam.
2. Students who pass the exam with distinction will have that indicated in their certificates and highest exam achievers will be given awards by the COE department.

This will encourage the students to take the exam seriously which will help provide proper assessment of outcomes. For the above reasons the ABET committee decided not to include the Exit Exam Average Score in the POs Assessment in T081.

Supporting courses

Table 3.6-10 shows the average score in supporting courses. These scores contribute in the assessment of following POs: (a), (f), (g), (l), and (m). The average score for each category (bottom row) is calculated for the students which are considered in the Rubric Assessment whenever the supporting course is taken by the student.

Table 3.6-10. Student Scores in Supporting Course for T081

COMPUTER ENGINEERING DEPARTMENT SUPPORTING COURSES GRADES IN T081									
	MATH 101	MATH 102	MATH 201	MATH 260	PHY 101	PHY 102	ENGL 214	IAS 211/212	STAT 319
199963540	1.50	2.50	2.00	1.00	1.00	1.00	2.50	1.00	3.50
200030620	2.00	1.00	1.00	2.50	1.00	1.50	3.00	3.50	2.50
200065010	1.50	1.00	1.50	1.50	1.50	2.00	2.50	3.75	2.00
200065270	1.00	2.50	1.00	1.00	2.00	1.50	3.50	3.75	1.00
200121410	3.00	3.50	3.50	2.00	2.50	4.00	3.00	3.75	3.50
200129710	2.00	1.50	1.00	2.00	2.50	2.00	1.50	1.00	4.00
200156310	1.50	1.50	1.50	2.00	2.50	2.00	3.50	3.75	2.50
200170430	3.75	3.75	3.75	3.75	4.00	3.00	2.00	4.00	3.00
200218240	3.00	1.00	1.50	1.00	1.00	1.00	2.00	3.50	2.50
200225080	3.00	1.00	2.00	3.50	2.00	2.00	3.00	3.50	2.50
200225280	2.50	2.00	1.50	2.00	1.00	2.50	3.50	3.75	1.50
200226900	1.00	2.00	1.50	2.00	1.50	1.50	2.00	3.50	2.50
200231700	2.00	1.00	2.00	3.00	1.00	1.50	3.50	1.50	2.00
200239800	2.00	3.00	2.00	3.00	2.00	1.50	2.00	3.50	2.50
200240560	4.00	4.00	4.00	4.00	4.00	4.00	3.75	3.75	3.75
200242900	3.00	2.00	3.00	3.50	2.50	1.50	1.00	3.50	1.00
200246360	1.00	1.00	1.00	1.00	2.00	1.00	3.00	3.50	3.00
200323890	4.00	4.00	4.00	4.00	4.00	4.00	3.75	4.00	4.00
200325630	1.50	3.75	3.50	3.50	2.50	2.50	3.50	4.00	2.50
200331210	3.00	2.00	2.50	1.50	2.00	2.50	2.00	3.50	2.00
200339590	2.00	2.00	2.50	4.00	2.00	1.50	3.00	3.50	3.75
200343950	2.50	1.00	2.00	2.50	2.50	1.50	3.50	3.00	2.00
200345610	3.00	4.00	4.00	4.00	4.00	2.50	3.50	4.00	4.00
200352790	3.50	3.50	3.50	3.00	2.50	3.50	3.50	4.00	4.00
200374830	4.00	2.50	3.50	3.50	3.50	4.00	4.00	3.50	3.75
200374890	3.75	3.75	3.75		4.00	3.50	3.75	3.75	
200376390	4.00	4.00	4.00	4.00	4.00	3.50	3.75	4.00	3.75
200376830	4.00	4.00	3.75	4.00	4.00	4.00	4.00	4.00	4.00
200376970	3.50	3.00	3.75	4.00	4.00	4.00	3.50	4.00	4.00
200378130	4.00	3.75	3.75	3.50	4.00	4.00	3.00	4.00	2.50
200378710	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
200378730	3.00	3.50	3.00	3.00	4.00	4.00	3.75	3.00	4.00
200379250	2.50	3.00	3.00	3.00	3.50	2.50	4.00	3.75	3.00
200468080	4.00	4.00	4.00	4.00	3.75	3.75	4.00	4.00	4.00
200468100	4.00	4.00	4.00	4.00	4.00	4.00	3.75	4.00	3.75
200468120	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.75	4.00
200473740	3.50	3.50	4.00	3.50	4.00	4.00	3.50	3.75	4.00
AVERAGE						2.81	3.16	3.51	3.06

Exit Survey

Results of deploying the Exit Survey in Term 081 are considered here as one of the indirect tools for PO assessment. Table 3.6-11 shows the detailed mapping of the exit survey questions to the POs using the current survey setting. Figure 3.6-2 plots the level of satisfaction (percentile) of graduating students for the Pos, which summarizes the above results. The students acknowledge the achievement of many POs like (a), (c), (d), (e), (g), (j), and (k). It is clear that these POs are adequately addressed in many core coursers in the curriculum. Below we list the concerns raised and the way the ABET committee is addressing them:

1. Although most POs received scores exceeding 70%, some soft outcomes like (f), (h), and (i) received less than 80% and can be pointed as needing some consideration. The ABET committee believes the improvement should come from the application of these outcomes in the rubric courses because the students obtained good grades in the related supporting courses. For example the average student score in IAS 212 (Ethics) is 3.51/4.0 and the student rated their achievement for outcome (f) as 3.76/5 or 3.00/4.
2. The level of satisfaction (percentile) of PO (b) is the lowest as it scores 65%. A special attention is being dedicated to the COE instructional labs. In T082, a faculty was assigned (Dr. M. Elrabaa) to visit each lab and discuss the student learning process, lab organization, and availability of manuals and datasheets. The objective was to address the above concern with the lab instructors to improve student learning.
3. The Graduating Exit survey in 062, 071, 072, and 081 indicated the need to improve in the following issues: the academic planning, student career planning, and the quality of academic supervision. For this the committee requested and monitored the improvement of the Web published advising material (student guide) and COE program details. The department requested the faculty to spend enough time with the student for advising especially during the pre-registration period.

While examining the Exit Survey data in T082, the ABET committee noticed the need to revise the Exit Survey to focus also on the achievement of the Program Outcomes and to provide more direct mapping to the outcomes. Specifically the survey has been revised to address also the ability and skills in addition to the various aspects of the Learning Environment. The ability and skills must have more direct mapping to the POs. The revised Exit Survey as well as the analysis of the exit survey will be part of the display material.

Table 3.6-11. Exit Survey Results for T081

Exit Survey for T081	Detail	Average
Outcome (a): • My education at KFUPM has given me the ability and confidence to apply general principles of mathematics, science, and engineering to the analysis of computer engineering problems. • Quality of instruction in: 1. Mathematics, Physics, and Chemistry	4.33 3.73	4.03
Outcome (b): • Quality of Laboratories: Experiments and lab manuals • Quality of Laboratories: Instruction provided by lab instructors	3.68 2.90	3.29

Outcomes (c) and (e): • The quality and variety of COE design projects have been very helpful in developing my engineering design skills. • The training and practice I had in my ICS courses at KFUPM has been very helpful to me in the areas of software design and development.	4.14 3.95	4.05
Outcome (d): • The teamwork experience that I had in my COE projects has taught me how to function as an effective team member and has been more productive to me than individual work. • My rating of the instruction and guidance I received in teamwork.	4.33 3.95	4.14
Outcome (f): • The COE program has provided me with adequate opportunities to help me understand and appreciate the importance of superior work ethics in the practice of my profession. • The COE program has provided me with adequate opportunities to help me understand and appreciate the importance of good character in the practice of my profession.	3.77 3.76	3.76
Outcome (g): • My education at KFUPM and my oral presentations have improved my ability to communicate my ideas effectively to my audience. • My education at KFUPM and the technical reports that I wrote for my course projects have improved my writing skills and my ability to communicate my ideas effectively in writing • My rating for the quality of guidance and instruction I received in writing and speaking.	4.20 4.25 4.00	4.15
Outcome (h): • My education in the COE department at KFUPM has contributed to my understanding of the impact of computer engineering solutions in my society and in the world.	3.86	3.86
Outcome (i): • My education in the COE department at KFUPM enabled me to pass professional and certificate exams to improve my career opportunities • My education in the COE department at KFUPM has prepared me to enter graduate school and to engage in a lifelong learning process.	3.75 3.70	3.73
Outcome (j): • The courses I have taken at KFUPM and the COE have given me a good foundation for understanding the contemporary social, political, and technical issues that surround our society.	4.05	4.05
Outcome (k): 1. My education in the COE department at KFUPM enabled me to use software and hardware tools needed to solve computer engineering problems.	4.00	4.00

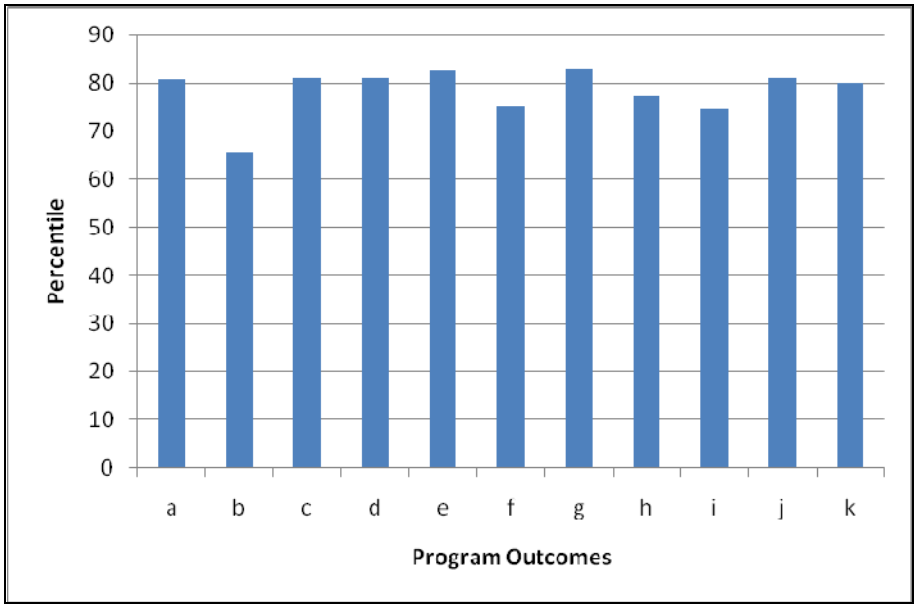


Figure 3.6-2. Exit Survey: Percentile of Satisfaction for the POs.

COOP Supervisor Survey and Employer Survey

The COE provides an optional COOP program. Very few COE students selected the COOP option in T081. As a result only two COOP Supervisor Surveys were filled. Figure 3.6-3 and Figure 3.6-4 show the COOP Supervisor and Employer satisfaction level with the POs, respectively. It is clear that these two results are quite different as the first refers to the COE student and the second refers to the COE Alumni. For both Figures, the POs relevance (Expected) and student actual performance (Actual) are shown in the left and right columns, respectively.

For the COOP supervisors, the average score ranged between Good to Very Good. The exception was that one supervisor thought that outcomes (l) and (m) are not needed much for the COOP training. The level of satisfaction exceeds the 70% threshold for all the POs and many POs achieved a satisfaction level of 80% or more. The Supervisors were least satisfied with outcome (d) which on Teamwork.

For the Employers, the average score ranged between Good to Very Good. The level of satisfaction(60% to 66%) was least for outcomes (a), (c), (d), and (j). This indicates that the COE alumni needs improvement in Engineering Design (outcome c), Communication skills (outcome d), use of math/science (outcome a), and life-long learning (outcome j). These factors are considered in conducting continuous improvement over some program outcomes.

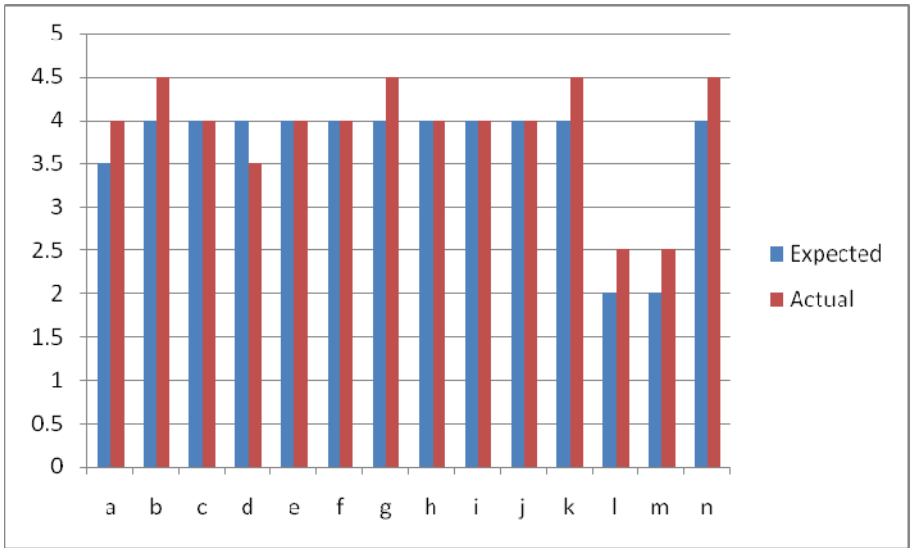


Figure 3.6-3. COOP Supervisor Survey: percentile of satisfaction for the POs

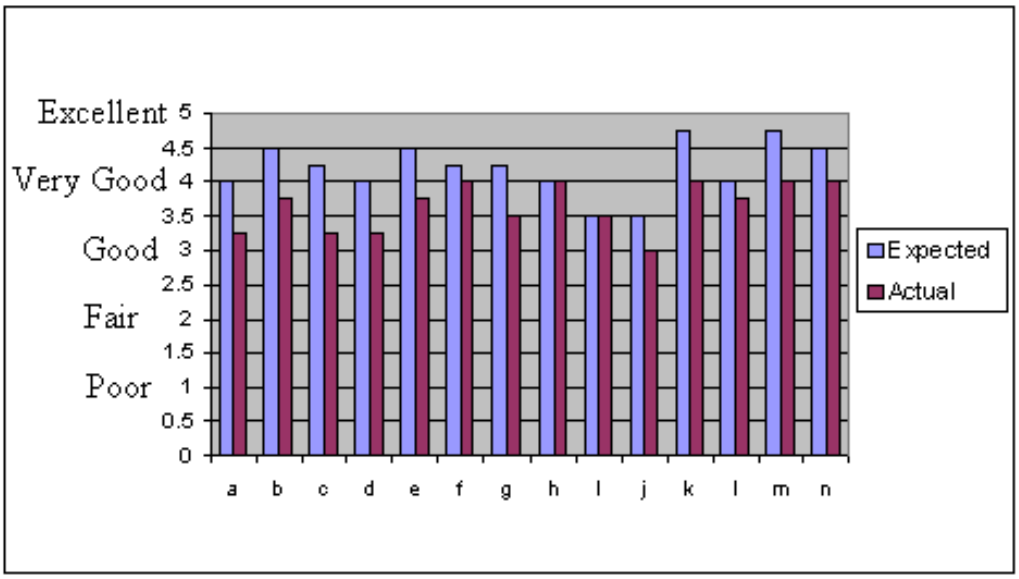


Figure 3.6-4. Employer Survey: percentile of satisfaction with the POs

Rubric Assessment

The detailed Rubrics data for T062, T071, T072, and T081 is presented as part of the display material. The data provides student-by-student rating for each rubric based on the previously defined performance indicators. By referring to the performance criteria (see Table 3.6-2) for each outcome, it is clear that the rubric data is designed to better reveal how actual learning by students is judged for each Program Outcome.

Table 3.6-12 shows the Rubrics Assessment Scores for the POs based on the assessment data for T062, T071, T072, and T081. Note that assessment of teamwork (outcome (d)) has two components: assessment by pears (d-I) and by instructor (d-II). Also the outcome on communication skills (g) has two components: (g-O) for oral communications, and (g-W) fro written communications.
The average rubrics score for terms T062, T071, and T072 is also shown. The above average score was considered as an indicator for rubrics assessment in the beginning of Term T081 in the process of carrying out the Continuous Improvement process for the first time. Table 3.6-12 does not include outcomes (l) and (m) because these outcomes are assessed using the average grade from STAT 319 and the course on "Discrete Structures" (ICS 212), respectively.

To analyze outcome achievement based on the rubric assessment data, the ABET committee compared the performance score achieved by each PO to the corresponding performance target (2.5 out of 4) as stated in the overall Assessment process described in Table 3.6-2. The POs have been marked with Achieved “A”, Marginally Achieved “MA” marginal, or Need Improvement “NI” depending of whether the PO meets or does not meet the performance target. The ABET committee observed the following:

1. Figure 3.6-5 summarizes the level of achievement of the Program Outcomes for Terms T062, T071, and T072. The ABET committee conclusions are:

a. Outcomes (b), (d-I), (d-II), (e), (f) ,(g-O), (i), (k), and (n) are all achieved as they meet the previously defined performance criteria.

b. Outcomes (a) is NI, (c) is MA, (g-W) is MA, (h) is NI, and (j) is NI. It has been found that these outcomes need some improvement.

Note that some corrective actions have been conducted (T081) in view of the above observations. These corrective actions will be described in details in Criterion 4 "Continuous Improvement".

2. Figure 3.6-6 summarizes the level of achievement of the Program Outcomes for Terms T081. The ABET committee conclusions are:

   a. PO outcomes (a), (b), (c), (d-I), (e), (f) ,(g-O), (i), (k), and (n) have all been achieved as they meet the previously defined performance criteria.

   b. PO outcomes (d-II) is NI, (g-W) is NI, and (h) is MA. It has been found that these outcomes need some improvement.

Table 3.6-12. Rubrics Assessment Data for T062, T071, T072, and T081

Average	Rubrics Assessment Data													
	a Math	*b Exp*	*c Des*	*d-I Team (Peer-Eva)*	*d-II Team (Instr-Eva)*	*e Form*	*f Ethics*	*g-O Com (Oral)*	*g-W Com (write)*	*h Impact*	*i Learn*	*j Cont*	*k Tool*	*n H/S*
T062	*2.47*	*3.24*	*2.59*	*3.24*	*3.19*	*2.75*	*2.58*	*2.84*	*2.44*	*2.38*	*2.75*	*2.25*	*3.07*	*2.71*
T071	*1.93*	*3.17*	*2.35*	*2.51*	*3.00*	*2.90*	*3.50*	*2.79*	*2.53*	*2.02*	*3.05*	*1.75*	*2.61*	*2.68*
T072	*2.98*	*3.48*	*3.20*	*3.22*	*3.31*	*3.00*	*3.00*	*2.88*	*2.80*	*2.45*	*3.16*	*2.73*	*3.16*	*2.92*
Average for last three semester (beginning of T081)	*2.46*	*3.3*	*2.71*	*2.99*	*3.17*	*2.88*	*3.03*	*2.84*	*2.59*	*2.28*	*2.99*	*2.24*	*2.95*	*2.77*
Comparing to Performance Target (2.5)	***NI***	***A***	***MA***	***A***	***A***	***A***	***A***	***A***	***MA***	***NI***	***A***	***NI***	***A***	***A***
T081 (beginning of T082)	*3.06*	*2.98*	*3.17*	*3.59*	*2.44*	*3.47*	*3.0*	*2.79*	*2.29*	*2.67*	*3.35*	*2.78*	*3.47*	*2.68*
Comparing to Performance Target (2.5)	***A***	***A***	***A***	***A***	***NI***	***A***	***A***	***A***	***NI***	***MA***	***A***	***A***	***A***	***A***
Overall														

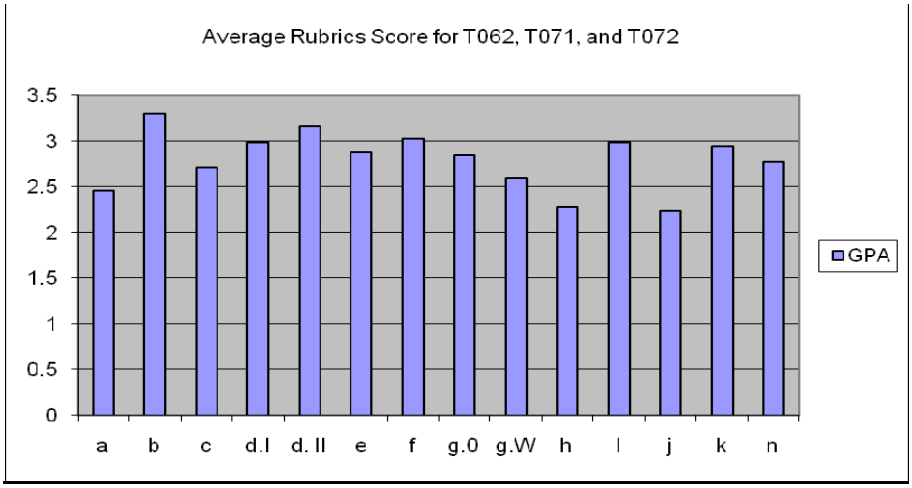


Figure 3.6-5. Average Rubrics Score for T062, T071, and T072.

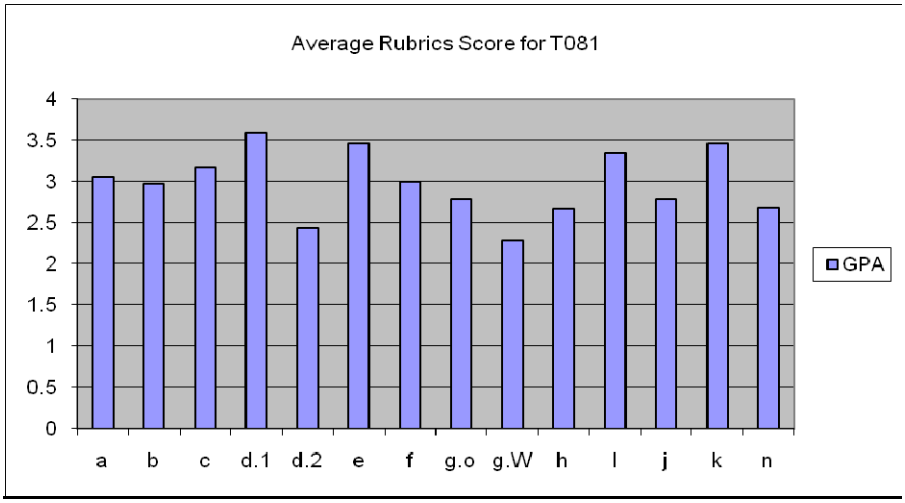


Figure 3.6-6. Average Rubrics Scores for T081.

Overall POs Achievement

In the previous sub-sections we presented the data collected from each assessment tool and the average scores for each category.

In this section the average scores collected from various assessment tools are integrated into a single table to help assess the achievement of the POs. Table 3.6-13 presents the overall POs achievement.

Table 3.6-13 presents the PO in the first column, the assessment method in the second column, the level of achievement through multiple assessment tools in the third column, and finally the committee comments on the achievement based on comparing the level of achievement to the performance target for each program outcome.

Table 3.6-13. Integration of Assessment Data for Program Outcomes

Program Outcome	Assessment & Evaluation Methods	Performance Target	Level of achievement (Information handled in T081 and T082)	Achievement of the Outcome (T081 and T082)
(a) an ability to apply knowledge of mathematics, science, and engineering.	Rubric assess. through COE 400, COE 485 and COE 351	A score ≥ 2.5 out of 4	Score of 2.46 for T062, 071, 072 and a score of 3.06 for T081	Below target score till T081.
	Math 101, Math 102, Math 201, Math 260, Phys. 101, Phys. 102	A score ≥ 2.5 out of 4	Score of 2.81 for Math(101, 102, 201, 260), and Phys(101, 102)	Good student achievements in basic sciences
	Graduate Exit Survey	A score ≥ 3 out of 5	Score of 4.03/5	Students rated their learning as very good.
	COOP Employer Survey	A score ≥ 3 out of 5	Score of 4/5	COOP-Sup: Very good Emp.: Good
(b) an ability to design and conduct experiments, as well as to analyze and interpret data	Rubric assess. through COE 400, COE 344 and COE 305	A score ≥ 2.5 out of 4	Score of 3.3 for T062, 071, 072 and a score of 2.98 for T081	Above target score.
	Graduate Exit Survey	A score ≥ 3 out of 5	Score of 3.29/5	Students rated their learning as acceptable
	COOP Employer Survey	A score ≥ 3 out of 5	Score of 4.5/5	COOP-Sup: Very good Emp.: Good-V. Good
(c) an ability to design a system, component, or process to meet desired needs	Rubric assess. through COE 400, COE 485 and COE 351	A score ≥ 2.5 out of 4	Score of 2.71 for T062, 071, 072 and a score of 3.17 for T081	Marginally above target score till T081.
	Graduate Exit Survey	A score ≥ 3 out of 5	A score of 4.05/5	Students rated their learning as very good
	COOP Employer Survey	A score ≥ 3 out of 5	Score of 4/5	COOP-Sup: Very good Emp.: Good
(d) an ability to function on multi-	Rubric assess. through COE 400, COE 485 and COE 351	A score ≥ 2.5 out of 4	Peer (d-I)/Instr. (d-II): Score of (2.99, 3.17) for T062, 071, 072 and a score of (3.59, 2.44) for T081	d-I: students are above target score. D-II: above target till T081 where it is below target

teams ***(d-I: Evaluation by peers, d-II: Evaluation by instructors)***				score.
	Graduate Exit Survey	A score ≥ 3 out of 5	A score 4.14 /5	Students rated their teamwork as Very Good
	COOP Employer Survey	A score ≥ 3 out of 5	Score of 4/5	COOP-Sup: Very good Emp.: Good
(e) an ability to identify, formulate, and solve engineering problems	Rubric assess. through COE 400, COE 485 and COE 351	A score ≥ 2.5 out of 4	Score of 2.88 for T062, 071, 072 and Score of 3.47 for T081	Above target score and being improving
	Graduate Exit Survey	A score ≥ 3 out of 5	A score of 4.05/5	Students rated their learning as very good
	COOP Employer Survey	A score ≥ 3 out of 5	Score of 4/5	COOP-Sup: Very good Emp.: Good-V. Good
(f) an understanding of professional and ethical responsibility	Rubric assess. through COE 390	Average GPA ≥ 2.5 out of 4	Score of 3.03 for T062, 071, 072 and Score of 3.0 for T081	Students practice is rated as Very Good
	Av. Grade in IAS 211/212	A score ≥ 2.5 out of 4	Score of 3.51 on IAS 211/212	Learning of basics is rated as Excellent
	Graduate Exit Survey	A score ≥ 3 out of 5	A score of 3.76/5	Students rated their learning as very good
	COOP Employer Survey	A score ≥ 3 out of 5	Score of 4/5	COOP-Sup: Very good Emp.: V. Good
(g) an ability to communicate effectively ***(g-O: Oral Comm., g-W: Writing Comm.)***	Rubrics Assess. Through COE 400, COE 485, COE 399 and COE 351	A score ≥ 2.5 out of 4	Oral (g-O)/Writing (g-W): Score of (2.84, 2.59) for T062, 071, 072 and Score of (2.79, 2.29) for T081	g-O: Oral Comm. above target score. g-W: Wrg. Comm. below target score.
	Av. score in ENGL 214	A score ≥ 2.5 out of 4	Score of 3.16 on ENGL 214	Learning of basics is rated as Excellent.
	Exit Survey	A score ≥ 3 out of 5	A score of 4.15/5	Students rated their abilities as Excellent
	COOP Employer survey	A score ≥ 3 out of 5	Score of 4/5	COOP-Sup: Very good

				Emp.: Good-V. Good
(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context	Rubric Assess. through COE 400, COE 485 and COE 351	A score ≥ 2.5 out of 4	Score of 2.28 for T062, 071, 072 and Score of 2.67 for T081	Below target score till T081 where it is marginally above target score
	Graduate Exit Survey	A score ≥ 3 out of 5	A score of 3.86/5	Students rated their learning as very good
	COOP Employer Survey	A score ≥ 3 out of 5	Score of 4/5	COOP-Sup: Very good Emp.: V. Good
(i) a recognition of the need for, and an ability to engage in life-long learning	Rubrics Assess. through COE 400, COE 485 and COE 351	A score ≥ 2.5 out of 4	Score of 2.99 for T062, 071, 072 and Score of 3.35 for T081	Below target score till T081 where it is above target score
	Graduate Exit Survey	A score ≥ 3 out of 5	A score of 3.73/5	Students rated their learning as Very Good
	COOP Employer survey	A score ≥ 3 out of 5	Score of 4/5	COOP-Sup: Very good Emp.: Good-V. Good
(j) knowledge of contemporary issues	Rubrics Assess. through COE 400, COE 485 and COE 351	A score ≥ 2.5 out of 4	Score of 2.24 for T062, 071, 072 and Score of 2.78 for T081	Below target score till T081 where it is marginally above target score
	Graduate Exit Survey	A score ≥ 3 out of 5	A score of 4.05/5	Students rated their learning as Excellent.
	COOP Employer survey	A score ≥ 3 out of 5	Score of 4/5	COOP-Sup: Very good Emp.: Good
(k) an ability to use the techniques, skills, and modern engineering tools necessary for	Rubrics Assess. through COE 400, COE 485 and COE 351	A score ≥ 2.5 out of 4	Score of 2.95 for T062, 071, 072 and Score of 3.47 for T081	Above target score
	Graduate Exit	A score ≥ 3 out	A score of 4.0	Students rated their

engineering practice.	Survey	out of 5		learning as Excellent
	COOP Employer survey	A score ≥ 3 out of 5	Score of 4/5	COOP-Sup: Very good Emp.: V. Good
(l) Knowledge of Probability and Statistics and their applications in Computer Engineering	Av. score in STAT319	Average GPA ≥ 2.5 out of 4	Score of 3.06 on STAT 319	Learning of basics is rated as Very Good.
	Graduate Exit Survey	A score ≥ 3 out of 5	N/A	N/A
	COOP Employer survey	A score ≥ 3 out of 5	Score of 2.5/5	COOP-Sup: fair Emp.: Good-V. Good
(m) Knowledge of Discrete Mathematics	Av. score from ICS 251/252	Average GPA ≥ 2.5 out of 4	Score of 2.76 on ICS 251 / 252	Learning of basics is rated as Good.
	Graduate Exit Survey	A score ≥ 3 out of 5	***N/A***	***N/A***
	COOP Employer survey	A score ≥ 3 out of 5	Score of 2.5/5	COOP-Sup: fair Emp.: V. Good
(n) The ability to design a system that involves the integration of hardware and software components	Rubrics Assess. through COE 400, COE 485 and COE 351	A score ≥ 2.5 out of 4	Score of 2.77 for T062, 071, 072 and Score of 2.68 for T081	Marginally above target score
	Graduate Exit Survey	A score ≥ 3 out of 5	***N/A***	***N/A***
	COOP Employer survey	A score ≥ 3 out of 5	Score of 4/5	COOP-Sup: Very good Emp.: V. Good

We summarize below the POs achievement as follows:

a. **The POs which are considered "Achieved" by T082 are (b), (e), (f), (g-O), (i), (k), (l), (m), (n).** However, we have the following reservations:

   - Outcome (i): although the students rated their learning as Very Good, this outcome has been below target score till T081 where it is above target score.
   - Outcome (n): has been marginally above target score.

1. **The POs which are considered "Not Achieved" by T082 are (a), (c), (d-II), (g-W), (h), and (j).** The committee comments are the following:

   - Outcome (a): although the students rated their learning of basic sciences as Very Good, this outcome has been below target score till T081 where it is above target score.
   - Outcome (c): although the students rated their engineering design as Very Good, their practice is still rated as marginally above target score till T081.
   - Outcome (d-II): although the students rated their teamwork as Very Good, their teamwork rating by their instructor was above target till T081 where it is below target score.
   - Outcome (g-W): although the students rated their Writing Communication skills as Excellent, the rating of their instructor was below target score.
   - Outcome (h): although the students rated their Understanding of the Impact of Engineering Solutions as Very Good, the rating of their instructor was below target score till T081 where it is marginally above target score.
   - Outcome (j): although the students rated their Knowledge of Contemporary Issues as Excellent, the rating of their instructor was below target score.

In conclusion, the committee decided a 2-year continuous improvement plan as to address the above finding of the level of achievement of the POs. The 2-year plan consists of:

- Improving Outcome (c) and (g-W) in the current academic year 2008-2009. These outcomes were selected first because of their importance to the program,
- Improving Outcome (a), (d-II) , (h), and (j) in the next academic year 2009-2010.
- Repeat the above assessment process and analysis, and monitor the results.

CRITERION 4. CONTINUOUS IMPROVEMENT

This section consists of two subsections 4.1 and 4.2. Subsection 4.1 describes the available information used in making decisions regarding program improvements based on curriculum revisions. Subsection 4.2 describes actions taken to improve the program based on ABET Criterion. We also presents the implementation details of each action and the results of the implementation.

4.1. Information Used for Program Improvement

Continuous improvement of the COE program is a continuous task that is carried out by the curriculum and the ABET Committees. Curriculum revisions or corrective actions proposed by either of the above committees are presented to all COE faculty members in council meetings for discussion, review, and approval. The COE faculty actively participate in council discussions leading to a finalized set of curriculum revisions and/or corrective actions. This section consists of the following two parts:

1. Reporting on **curriculum revisions** performed by the curriculum committee over the period 1999 to 2006. The revisions can be broken down into the following items:
    a. Statement of the old PEOs and POs (1999).
    b. First Cycle of Curriculum Assessment-Correction (1999-2001) which was carried out in response to the comments/assessment of the ABET team who evaluated the program. The concerns raised by the ABET team and the corrective actions that were taken by the department are presented.
    c. Second Cycle of Curriculum Assessment-Correction (2001-2004) was based on a self-assessment team chaired by an invited faculty from another University. To assess the performance of the COE graduates in light of the stated program objectives and program outcomes, a number of surveys were conducted such as the exit survey, alumni survey, and employers' survey. The team also consulted extensively with COE faculty and students through public meetings and surveys. Benchmarks were also identified that define the various measures of success, which would be used over the next five years to quantify achievements and progress.
    d. Third Cycle of Curriculum Assessment-Correction (2004-2007) aimed at refining the program by removing overlaps, redundancies and gaps from courses, updating course contents, etc.
    e. Current Cycle of Curriculum Assessment-Correction (2005-2009) during which the COE department has embarked upon a major task of reviewing and upgrading our assessment process itself. In Term T061, the COE department started collecting assessment data based on ABET assessment tools. Some early actions have already been proposed and

implemented for improving students' communication skills, knowledge of contemporary issues and impact of engineering solutions on society. This cycle is still ongoing.

The details of the curriculum revisions for the above period will be part of the display material.

2. Reporting on the **continuous improvement process which is based on ABET Criterion**. This process was carried out in 2008-2009 by the COE ABET Committee. The continuous improvement process uses the results from the analysis on achieving the PEOs (Criterion 2) and POs (Criterion 3) and more specifically the information described in Table 3.6-13 which integrates all direct and indirect assessment data for each outcome.

In the next sub-section we present the second part which reports the continuous improvement actions that were carried out in 2008-2009 by the COE ABET committee.

4.2. Action to Improve the Program

The process of direct and indirect assessment started in 2007, it has taken two years to mature into an acceptable level. Using the collected direct and indirect assessment data, the COE ABET Committee started analyzing the level of achievement of each program outcome in the academic year 2008-2009. The committee has made use of the POs achievement data as the basis for improving some POs in each semester in accordance with the COE Assessment Plan. In T081, the COE ABET committee started implementing the process adopted for continuous improvement in the COE Program.

The POs assessment process uses the following assessment channels: (1) the Exit Exam, (2) the average score in supporting courses, (3) the Exit Survey, (4) the COOP Supervisor and Employer Surveys, and (4) the Rubrics score for a set of representative core junior and senior courses

In Criterion 3, the status of the POs were grouped together in one single assessment table (see Table 3.6-13) which includes for each PO the results of various assessment channels, the performance criteria, the score representing the level of achievement, and a summary of the committee comments. Following the analysis of the assessment data, the committee adopted a 2-year continuous improvement plan consisting which of:

a. Improving Outcomes (c) and (g-W) in the current academic year 2008-2009. These outcomes were selected first because of their importance to the program,
b. Improving Outcome (a), (d-II) , (h), and (j) in the next academic year 2009-2010.
c. Repeat the above assessment process and analysis for continued improvement.

In the following sub-sections we address item (a) as follows:

a. Corrective Action 1: Improving Program Outcome (c) in T081.
b. Results from Corrective Action 1.
c. Corrective Action 2: Improving Program Outcome (g-W) in T082.
d. Recommendation from the IAC and Continuous Improvements.

Corrective Action 1: Improving Program Outcome (c) in T081

In T081, following the analysis and examination of the Rubric Assessment Data and the available indirect assessment data for the past three semesters (Table 3.6-13), the committee decided to take Continuous Improvement measures for the Program Outcome on Engineering Design (c) and Dr. Mayez Al-Mouhamed (will be referred to as faculty in charge) has been nominated to conduct the above process. Outcome (c) had a marginal score of 2.6/4, and accordingly was selected for improvement because of its importance to the COE program.

For Program Outcome on Engineering Design (c), the ratings of learning using direct measures with student-by-student. The rubric assessment data is presented as part of the display material. In addition, the display material presents the performance criteria used for the rating of each PO. Outcome "C" has five performance criteria: (1) translate general requirements, (2) identify and formulate any problem, (3) list different design alternatives, (4) choose the appropriate design, (5) fine tune the chosen solution. Average student performance was considered inadequate (score below 2.5 / 4) score for the performance criteria (2), (3), and (4). This indicates that the concept of Engineering Design needs to be better defined, practiced wherever possible, and be integrated as part of all the COE courses with a culminating engineering design experience in the Capstone course (COE 400), the Senior Design Project (COE 485), and the COOP (COE 351).

To close the loop, the faculty proposed the following action plan:

1. Deliver presentations to students aimed at improving outcome (c) "Engineering Design…" in relevant courses of the program, e.g. Embedded Systems COE 400, COE 485 Senior Design Project, and COOP course COE 351. The above courses are also used for Rubric Assessment.
2. Develop templates and guidelines for the students on Engineering Design.
3. Coordinate with the concerned course instructors to emphasize outcome (c) and to provide supporting material.
4. Explore how Engineering Design Education can be enhanced in the COE Program.
5. Propose a plan with short term and long term objectives for progressively introducing Engineering Design Education in the COE program Labs.
6. Develop or adapt educational material on Engineering Design for faculty lecturing, students reading, and provide web resource and references.

The following action steps were carried out:

1. **Action-1:** the faculty in charge arranged two meetings with Dr. A. Bouhraoua (instructor of COE 400 and COE 485), Dr. T. Sheltami (COE 485), and Dr. B. AL-Madani (COOP coordinator COE 351). The meetings led to the following conclusions:

   - Engineering education must be addressed in all relevant courses and labs of the COE program to better prepare the student to the practice of engineering design at the 400 level. This issue will be studied and a recommendation was forwarded by the faculty in charge to the COE Curriculum Committee for progressively implementing engineering design, whenever applicable, in all relevant COE courses and labs.

   - The faculty in charge provided Guidelines and reference material for enhancing Engineering Design.

   1. The instructor of each of the above courses is to develop a Case Study on Engineering Design or deliver at least two lectures to the students of each of the above courses. The objective is to expose the students to the Engineering Design Process within the framework of each course. In addition, the student should be exposed to the Evaluation Criteria and the Rubric Evaluation form which is used in the Rubric Assessment for the course. This is likely to influence the way the students deal with their projects during the semester and the writing of their project reports and presentation in some courses at the end of semester.

   2. The above course instructors delivered at least two-hour presentation to their respective students. Also COOP Students were provided with "Guidelines for the Student on Engineering Design" and were asked to apply these guidelines in their COOP tasks wherever possible.

2. **Action-2:** The faculty in charge arranged for the following educational material:

   - **Source-1:** Presentations on Engineering Design: concept, management tools, teaming, societal impact, economics, and ethics can be found at: http://jjackson.eng.ua.edu/courses/capstone/lectures/

   - **Source-2:** Detailed Guidelines on (1) Design Methods I, and (2) Design Handbook: Design Methods II. Chapters I and II (14 pages) from the Design Handbook can serve as the basis for a "Guidelines for the Student on Engineering Design" for the benefit of COE 400, 485, and 351 students.

   - Design Methods I:
     http://watchman.idlab.dal.ca/DesignLibrary/Courses/2900/2900.pdf

   - Design Handbook: Design Methods II:
     http://watchman.idlab.dal.ca/DesignLibrary/Courses/3901/Manual.pdf

- ABET definition: ABET-Design a System, Component, or Process: http://www.foundationcoalition.org/home/keycomponents/assessment_eval/outcome_c.html

3. **Action-3:** Recommendation to the COE curriculum committee. A number of action steps were conducted in T081 to improve the Engineering Design component in the above courses. The action conducted needs to be applied from now on as part of the above courses. The faculty in charge recommended to the COE curriculum Committee the following curricular actions to be applied as soon as possible:

   a. **Addressing Engineering Design in COE 400, COE 485, and COE 351:** It is recommended to revise the syllabus of COE 400, COE 485, and COE 351 using either of the following approaches:

      1. Lecture the students on a Case Study on Engineering Design (or similar material) to expose the students to the Engineering Design Process within the framework of each course.

      2. Deliver at least two lectures to emphasize the Program Outcome (c) "Engineering Design Component". Example of presentations can be found at URL:

         http://jjackson.eng.ua.edu/courses/capstone/lectures/

      For COE 351, the COOP coordinator should deliver the above presentations or at least communicate with the COOP students and send them presentations and guidelines to be used in the course of their COOP training and the writing of their final reports. The course grading and rubric assessment carried out in the above courses should assess the extent to which the students are applying the concepts learned in the above lectures. For each of the above courses, the students should be informed about the basis of course grading in connection with the above presented engineering design framework. Please see the ABET definition ABET for "Design a System, Component, or Process" at:

      http://www.foundationcoalition.org/home/keycomponents/assessment_eval/outcome_c.html

   b. **Extending the Engineering Education to the Junior level:** To develop a culture of Engineering Education at the COE, the engineering design concepts must be progressively implemented at different program levels. The approach used is to start with the 400-level. This has been initiated by a recommendation from the COE ABET committee in T081 to introduce some engineering design concepts at the 300-level, in the COE 305 "Microprocessor Systems" and COE 344 "Computer Networks". Table 4.2-1 provides a **Plan for the Progressive Introduction of Engineering Design (Design a**

System, Component, or Process) in the COE program. The column labeled 300-level in Table 4.2-1 describes aspects of Engineering Design to be addressed, at this phase, at this level.

Table 4.2-1. Plan for Progressive Introduction of Engineering Design

Elements of Engineering Design	200-level Courses	300-level Courses (proposed for T082)	400-level Courses (Conducted in T081)
1. **Identifying a need** (There is a need for solving this problem!, what is this need?)			**Identify the need for solving the problem and domain of application**
2. Defining the problem (The design task will be completed if I solve a specific problem, What is this problem**)**	**Word definition of the problem.**	**Word definition of the problem. Enforcing use of Notebooks in all activities.**	**Word definition of the problem. Enforcing the use of Notebooks in all activities.**
3. **Conducting research** (How and where to search the library, ebooks, datasheets, manufacturer web etc to find relevant material to solve the problem)			**Searching similar problems (wording) and proposed solutions**
4. Narrowing the research (knowing the problem to be solved I need to filter Software/Hardware components that may help in building a solution)			**Knowing relevant examples be able to identify a few similar systems**
5. **Analyzing set criteria** (knowing the problem, its specifications, and its relevant components found, I need to find out whether some components meet the problem specifications or not)		**Analysis of problem specifications and identify components meeting some of the above**	**Analysis of problem specifications and identify components meeting some of the above**
6. **Finding alternative solutions** (determine a few possible solutions using found components for the above problem, I need to identify each of these possible solutions),	**Using different approaches or components. Use of Notebooks.**	**Combining components to find different solutions.**	**Combining components to find different solutions**
7. **Analyzing possible solutions** (knowing the problem (specifications) and possible solutions I need to find out whether some solutions meets the problem specifications or not)		**Pruning possible solutions which do not meet the specifications**	**Pruning possible solutions which do not meet the specifications**
8. **Making a decision** (given two or more possible solutions I need to select one feasible and economical solution)	**Selecting an economical solution**	**Selecting the most economical feasible solution**	**Selecting the most economical feasible solution (ethics, environmental)**
9. **Presenting the product** (I need to describe my solution in writing using diagrams, graphics, drawings, etc.)			**Technical description of the design**

10. **Communicating** (prepare a written report in which each task is broken down into: Identifying a need, Defining the problem, Conducting research, Narrowing down the research, Analyzing set criteria, Finding alternative solutions, Analyzing possible solutions, and Making a decision.)	**A simple report describing the above steps.**	**A report defining the problem, specification, analysis of components vs specification, solutions, solution analysis, and decision**	**A report defining the problem, specification, analysis of components vs specification, solutions, solution analysis, and decision**

Results from the Corrective Action 1

The continuous improvement action of program outcome (c) was conducted in the beginning of T081. In the beginning of Term T082 (Spring 2009), the COE ABET Committee collected the Rubrics Assessment Data and analyzed the achievement of the program outcomes. Table 3.6-13 shows the POs Status based the assessment data at the end of Term T081. The committee noticed some improvement in Outcome (c). The rubrics data for (c) shows a 3.17/4.0 score compared to an average score of 2.6/4 for Terms T072, T71, and T062 . The above score should be monitored for the subsequent semesters in order to assess the overall effect of the conducted action.

Corrective Action 2: Improving Program Outcome (g-W) in T082

In T081, upon analysis and examination of the Rubric Assessment Data and the available indirect assessment data for the past three semesters (See Table 3.6-13) the committee decided to conduct a Continuous Improvement for the Program Outcome (g-W) and Dr. Radwan Abdel-Aal has been assigned to conduct the above process. Outcome "g-W" achieved a low score of 2.29/4 in Term T081 and it has been selected for improvement because of its importance to the COE program. The detailed performance indicators of outcome (g-W) will be presented as part of the display material.

An action was developed to study of the problem of low performance indicated by rubric assessment for the g-W outcome (Writing Skills) and to identify and implement corrective actions. The action plan and progress made towards improving (g-W) is shown in Table 4.2-2.

Table 4.2-2. Action Plan and Progress Made Towards Improving outcome (g-W)

	Step	Action/Description	Status
1	Examine results of rubric assessment on g-W over terms T082 and T091 and identify aspects that need improvement	The following rubric items showed an average score below 2.4 and therefore were deemed unsatisfactory and needed improvement: **a. Report Quality:** 1. Formulas and Equations (1.6) 2. Proper use of references (1.48) 3. Proper use of appendices (1.33) **b. Technical Content:** 1. The abstract (1.8) 2. Project management Plan (1.87) 3. Quality of Engineering Documentation (2.34)	Completed
2	Identify actions for improvement	The following possible actions have been identified:	
		1. Improve student awareness of the rubrics used to assess their writing skills: • Post the rubrics on the COE ABET webpage • Distribute rubrics to students taking relevant courses	In progress
		2. Provide recommended reading material for students to review on the COE ABET webpage that address the following topics: • Guidance on good technical writing in general • Guidelines on Report writing • Writing a good abstract • Proper use of equations, references, and appendices	In progress
		3. Prepare a presentation on material in item 2 above and - Post it on the COE ABSET webpage - See if it can be incorporated as a regular component in the COE 390 course, and if so amend course description accordingly	In progress
		4. Propose to the COE department to develop, approve and adopt a document on writing guidelines for use as a standard by undergraduate students	In progress

Program Improvements based on IAC Recommendations

First IAC Meeting held in April 2007

The first meeting of the COE Industry Advisory Committee was held on April 25, 2007, at the COE department. The meeting was also attended by all COE faculty and by students representative as the president and vice president of the CCSE Computer Club. The Dean of CCSE, chairmen of SE and ICS department were also invited to the meeting.

Minutes of the IAC meeting and discussion is presented as part of the display material. The above display material provides details about the comments raised by the IAC members. In the following comments made by the IAC members regarding the COE program are listed altogether with the way these comments were addressed and improvement actions undertaken (in italic) by the COE curriculum committee:

1. Inputs on the Educational Objectives:
    a. The nature of our business is to have engineers with both business and engineering backgrounds. This way the graduates can communicate with our staff and understand business issues commercially and financially.
    b. Good objectives, however, you need some focus on few areas to shine in and gain regional and world wide reputation. There is a breadth but not much depth in the overall objectives.
    c. Provide graduate engineers with ability of supporting the industry in the following fields: Communication network design, and Embedded system design

In its latest program revision (to be approved) a new core course on Management is proposed at the Senior-level. COE faculty are also discussing improving the COE program in the following directions to better prepare the COE graduates for the local industry: (1) Practice of Engineering Design, (2) Problem solving with some emphasis on Mathematical Analysis, (3) Business Analysis, (4) Advanced Database systems (specifically multi-dimensional databases), (5) Business Management and Finance.

The COE program has been revised to include three elective courses to provide more in depth specialization. These courses are generally taken from the area of Computer Networks and Communication and also in the area of Computer Applications. The following elective courses were proposed: COE 402 Computer System Performance, COE 444 Internetwork Design and Management, COE 446 Mobile Computing, COE 449 Network Security Engineering, COE 499 Data Management, COE 484 Introduction to Robotics, COE 420 Parallel Computing, and COE 403 Advanced Microprocessor Systems. Some of these courses are becoming very attractive for the students. Other courses are currently proposed in the area of High-Performance Computing.

2. The COE graduates lack wider exposure to High-performance Computing and Software areas, while the department appears to be stronger in other areas such as VLSI.

The program introduced two undergraduate and one graduate elective courses on High-performance Computing, which are: Parallel Computing (COE 420), Advanced Microprocessor Systems (COE 403), Parallel Processing Architecture (COE 502). A High-Performance Computer Cluster has been arranged at the Information Technology Centre (ITC). In COE 501 "Computer Architecture" a few students are doing their course project on using loop-level parallelism on the above cluster with OpenMP and MPI programming for shared-memory and distributed-memory parallelization, respectively.

3. Focusing on system design projects, one can design processor based systems with the minimum investment thereby providing more emphasis on system integration using available components. With this experience, the COE department should COOPerate with INTEL and other industries around.

The courses COE 400 "Embedded Systems" and COE 305 "Microprocessor Systems" have been revised and restructured to better address system design project integrating hardware and software components.

4. **T**here is no research data, and there is an urgent need to develop top-most quality and capability access to massive data – including data storage, retrieval, analysis, management and security. With regard to COOP/Summer training program, it was said that we have to consider the successful stories of COOP/summer training students.

One undergraduate course on Data Management COE 499 is introduced. It has been offered in Term T082 as elective course.

5. COOP work plan should be identified ahead of time before sending the students to the respective industry/company for COOP or summer training program. This work-plan should be prepared by the industry and sent to the University for approval so that students are aware of the projects they are going to work on before they join the industry for COOP program. This would also help the students prepare themselves in a much better way so that they can contribute to the projects and make better use of their COOP training.

Currently the Academic Advisor receives, analyzes, and approves the student COOP plan. This is also true for the two progress reports and final COOP report. Generally some revision in these report are made based on the above interaction. Although the academic COOP advisor interacts with the COOP student during the training, we believe there is room for improvement especially if arrangements are made by the University for the advisor to visit the student and discuss the training conditions with the Industry COOP supervisor.

6. Concern about the COE graduates, particularly regarding Communication and Presentation Skills, COE Graduates lack of exposure to current developments in information technology, and they need to be updated by the latest IT techniques currently used in the industry.

COE students are exposed to Oral and Written communication at all levels: the course on technical report writing (ENGL 214), the Seminar (COE 390), a set of course projects where a technical report is required, the COE 400 "Embedded Systems" and COE 485 "Senior Design Project" where the writing of technical reports is a critical requirement of the course. In T082, the Written Communication outcome (g-W) was selected for improvement action. Currently, corrective measures are being conducted to improve Written Communications skills of the COE students.

Second IAC Meeting held in May 2009

The IAC held its second meeting on May 31, 2009, at the COE department. The meeting was also attended by all COE faculty. The Dean of CCSE, chairmen of SE and ICS department were also invited to the above meeting. The meeting details are available as part of the display material.

A brief presentation about ABET Accreditation and Program Assessment was presented by the chairman of the ABET committee. All IAC members unanimously agreed on the PEOs, POs, and Program Assessment Plan. Following are the input provided by the members from Industry and the answers from the chairman of the ABET Committee:

- Q-1: To fulfill the local industry needs in KSA, the COE graduate should be educated and trained so that he can deliver high quality engineering work in a variety of job areas which do not necessarily fall in his area of specialization. Therefore, the success of the COE graduate depends on his ability to integrate within a multi-disciplinary team and be able to tackle the business problems and contribute to finding engineering solutions. In other words, student personal skills have to be developed and trained as part of the engineering education in the COE program.

  A-1: *To better serve the local industry and meet the regional needs, the COE faculty are currently addressing the above concerns within the curriculum revision. Specifically, the COE faculty are currently proposing tuning of the COE program to incorporate the following features:*

  - *Provide an educational environment to develop the student capabilities in: (1) general problem solving, (2) problem mathematical analysis, (3) practice of engineering design from requirement specifications to implementing a viable solution.*
  - *Understanding of business in general and be able to carry out business analysis and management, and understand financing systems.*

- *Emphasize the teamwork aspects throughout the program through education and practice.*

- Q-2: In the area of computing and IT, the current trends in KSA is shifting from the use of basic knowledge and skills (e.g. networks and communication) to the use of basic knowledge and skills at the application level. For this students need to learn also how to make use of the learned knowledge and skills at an application integrating a variety of requirements such as software and application-oriented aspects.

  A-2: In the current *curriculum revision, the COE faculty are currently reflecting on the creation of multiple streams within the COE program. At least two streams are proposed through the students selection of elective courses. These streams are: (1) computer architecture and embedded systems, and (2) computer networks and communications. Both streams culminate at the senior level by two different major design courses aimed at integrating the knowledge and skills acquired in the program in a major design experience. Here the focus is to integrate software and hardware within the framework of some engineering application.*

Minutes of the IAC meetings (April 2007 and May 2009) and discussion sessions will be part of the display material.

CRITERION 5. CURRICULUM

5.1. Program Curriculum

The COE Program provides students with an educational program that ensures the ability of its graduates to handle current and future needs of society. The Computer Engineering Program emphasizes three aspects. First, courses in basic sciences such as mathematics, and physics enable students to develop the necessary analytical ability and learn the underlying scientific principles. This aspect is complemented by subjects in humanities. Second, courses in computer engineering cover the basic background in COE as well as allow students to emphasize certain Computer Engineering disciplines through the choice of electives. Third, laboratory sessions provide exposure to engineering design and implementation of digital systems, microprocessors, digital communication, computer networks, and embedded systems. After completing the undergraduate program in Computer Engineering, the student is qualified to take on a job as a Computer Engineer or further develop his studies by enrolling in a graduate program.

Numerous work opportunities for Computer Engineers exist in the Kingdom, where graduates may work in the areas of digital communication, computer networks, and computer systems including the implementation of wired and wireless computer networks and protocols, network resource development and management, and software and hardware computer systems. Graduates are also required by industry for work in information processing, database systems, software development, and enterprise computer systems. Other opportunities exist in advanced electronics, industrial electronics, robotics, computer vision, and A.I.

This section is organized as follows:

a. Preparation for Engineering Practice
b. Culminating Design Experience
c. Requirements for Bachelor of Science in Computer Engineering

Preparation for Engineering Practice

The COE program implements an education in science, mathematics, engineering science, engineering design and general studies that meets or exceeds the expectations of the ABET criteria. The COE department requirements for a Bachelor of Science degree in Computer Engineering are summarized in Table 5.1-1 and Table 5.1-2. Those requirements are specified by the courses listed in sections (1) and (2a) of Table 5.1-1 for a B.Sc. in computer engineering without COOP. The minimum total number of credits for a B.Sc. in Computer Engineering with COOP is 131 while it is 130 for a B.Sc. in Computer Engineering without COOP.

Table 5.1-1. Curriculum of the Computer Engineering Program (Without COOP)

Year; Semester	Course Dept., Number, Title	Category (Credit Hours)			
		Math & Basic Science	Engineering Topics Check if contains significant design (√)	General Education	Others
1-Fall	Math 101 Calculus I	4			
	PHYS 101 General Physics I	4			
	Chem. 101 General Chemistry	4			
	ENGL 101 Engl. Composition I				3
	IAS 111 Belief and its Consequences			2	
1-Spring	Math 102 Calculus II	4			
	PHYS 102 General Physics II	4			
	ICS 102 Intro. to computing.				3
	ENGL 102 Intro. To Report Writing				3
	IAS 101 Practical Grammar			2	
	PE 101 Physical Educ. I				1
2-Fall	COE 202 Digital Logic Design		3 (√)		
	EE 201 Electric Circuits I		4 (√)		
	ICS 201 Introduction to CS				4
	Math 201 Calculus III	3			
	IAS 212 Professional Ethics			2	
	PE 102 Physical Educ. II				1
2-Spring	COE 205 Comp. Org. & Ass. Lang.		4 (√)		
	COE 203 Dig. Design Lab		1 (√)		
	ICS 202 Data Structures				4
	ICS 252 Discrete Structures	3			
	MATH 260 Intro. to Linear Algebra & Diff. Equations.	3			
	ENGL 214 Technical Report Writing				3

3-Fall	COE 305 Microcomputer System Design		4 (√)		
	Stat 319 Prob. & Stat. For Eng. & Sc.	3			
	COE 341 Data & Computer Comm.		3 (√)		
	COE/ICS/SWE XXX IT Elective		3 (√)		
	IAS 201 Writing for Prof. Need			2	
3-Spring	COE 308 Computer Architecture		3 (√)		
	COE 344 Computer Networks		4 (√)		
	COE 390 Seminars				1
	EE 203 Electronics I		4 (√)		
	XXX xxx Free Elective				3
	IAS 311 Islamic Shariah			2	
	COE 399 Summer Training		0 (√)		
4-Fall	COE 485 Senior Design Project		3 (√)		
	COE 4XX COE Elective		3 (√)		
	ICS 431 Operating Systems				4
	COE 360 Principles of VLSI Design.		3 (√)		
	IAS 301 Literary Styles			2	
4-Spring	COE 400 System Design Lab		3 (√)		
	COE 4XX COE Elective		3 (√)		
	XXX xxx Free Elective				3
	XXX xxx General Elective				3
	IAS 4XX IAS Elective			2	
Total ABET Basic level Requirements		32	48	14	36
Overall Total for Degree	130				
Percent of Total		24.6%	36.9%		
Minimum Total Must Satisfy one Set	Minimum Semester credit hours	32	48		
	Minimum Percentage	25%	37.5		

The program for students with the COOP option is the same as that for students with the non COOP option except for the fourth and fifth years (see Table 5.1-2).

Table 5.1-2. Curriculum of the Computer Engineering Program (With COOP)

Year; Semester	Course Dept., Number, Title	Category (Credit Hours)			
		Math & Basic Science	Engineering Topics Check if contains significant design (√)	General Education	Others
1-Fall	Math 101 Calculus I	4			
	PHYS 101 General Physics I	4			
	Chem. 101 General Chemistry	4			
	ENGL 101 Engl. Composition I				3
	IAS 111 Belief and its Consequences			2	
1-Spring	Math 102 Calculus II	4			
	PHYS 102 General Physics II	4			
	ICS 102 Intro. to computing.				3
	ENGL 102 Intro. To Report Writing				3
	IAS 101 Practical Grammar			2	
	PE 101 Physical Educ. I				1
2-Fall	COE 202 Digital Logic Design		3 (√)		
	EE 201 Electric Circuits I		4 (√)		
	ICS 201 Introduction to CS				4
	Math 201 Calculus III	3			
	IAS 212 Professional Ethics			2	
	PE 102 Physical Educ. II				1
2-Spring	COE 205 Comp. Org. & Ass. Lang.		4 (√)		
	COE 203 Dig. Design Lab		1 (√)		
	ICS 202 Data Structures				4
	ICS 252 Discrete Structures	3			
	MATH 260 Intro. to Linear Algebra & Diff. Equations.	3			
	ENGL 214 Technical Report Writing				3

3-Fall	COE 305 Microcomputer System Design		4 (√)		
	Stat 319 Prob. & Stat. For Eng. & Sc.	3			
	COE 341 Data & Computer Comm.		3 (√)		
	COE/ICS/SWE XXX IT Elective		3 (√)		
	EE 203 Electronics I		4 (√)		
	IAS 201 Writing for Prof. Need			2	
3-Spring	COE 308 Computer Architecture		3 (√)		
	COE 344 Computer Networks		4 (√)		
	COE 390 Seminars				1
	COE 360 Principles of VLSI Design.		3 (√)		
	ICS 324 Database Systems		4 (√)		
	IAS 311 Islamic Shariah			2	
4-Fall	COE 351 COOP. Work		9 (√)		
4-Spring	COE 400 System Design Lab		3 (√)		
	COE 4XX COE Elective		3 (√)		
	ICS 431 Operating Systems				4
	XXX xxx General Elective				3
	IAS 301 Literary Styles			2	
	IAS 4XX IAS Elective			2	
Total ABET Basic level Requirements		32	55	14	30
Overall Total for Degree	131				
Percent of Total		24.4%	42%		
Minimum Total Must Satisfy one Set	Minimum Semester credit hours	32	48		
	Minimum Percentage	25%	37.5		

Culminating Design Experience

For the first and second year, Computer Engineering students cover mainly basic sciences and mathematics subjects. In addition, some courses belonging to the general education component are also planned such as ENGL and PE courses. During the second year, students also complete ICS 102 where they are introduced to programming language very early in their program.

For the third year, students must complete the COE 202, COE 203, and COE 205. The COE 202 introduces the basics of logic design for combinational and sequential circuits with applications. The corresponding lab COE 203 emphasizes the use of FPGAs to implement combinational and sequential circuits. The students use various software tools to model, simulate and implement digital circuits. The COE 205 emphasizes the use of assembly language tools such as the Microsoft Macro Assembler, Linker, and Debugger to develop, analyze, and debug Intel x8086 assembly language programs. The student's COE laboratory experience is also reinforced with the required laboratory work in COE 205. The COE 205 lab work emphasizes the use of tools and provides hands on experience in assembly language programming. The course project is intended to make the students apply the concepts learned in the course in designing and implementing a program satisfying a given functionality through team work. The project also involves requirements of self-learning capability.

For the fourth year, students will complete COE 305, COE 341 and an IT elective for the first semester. COE 305 extends the knowledge base of COE 203 and COE 205 and focuses on microprocessor architecture and organization and related topics. This course is tightly coupled to its lab which exposes the students to various aspects of microprocessor engineering including signal analysis, design and implementation of medium-sized 80x86 microprocessor based system, testing, hardware troubleshooting, and conducting I/O interfacing experiments using professional processor kits. In COE 341, the students are introduced to the concepts of data and computer communications. The course lays the ground for subsequent courses in the program on networking. It includes a programming assignment where students use software tools to develop skills for the simulation, analysis, and design of communication processes and components. A term paper assignment gives students exposure to recent developments in the field and enhances their aptitudes for research and self-learning. For the second semester students must complete COE 308, COE 344, and COE 390. In COE 308, students cover topics in computer architecture that includes memory management, integer and floating point arithmetic, pipelining, and superscalar architectures. Reduced Instruction Set Computers, parallel architectures, and interconnection networks are amongst the topics covered in the course. In addition, the course emphasizes the use of MIPS assembly language tools such as the SPIM and MARS software simulators to develop, analyze, and debug MIPS assembly language programs. It also emphasizes the use of simulators for the design and the simulation of the datapath and control of a processor. The course project is intended to build the students' ability to design, implement, simulate, and test the operation of a simple pipelined processor. COE 344, builds on the knowledge base of COE 341 and covers topics including OSI model, WAN and LAN design issues. In addition, it

tackles in depth the application layer, transport layer, network layer, and medium access layer from design, protocol, and analysis perspective. In the associated lab allows the students to utilize software and hardware tools to develop skills in the design, implementation, and analysis of computer networks. Finally, COE 390 is designed to improve students` ability for presenting their technical work and to introduce students to engineering as a profession, codes of professional conducts, ethics and responsibility, and the role of engineering societies and organizations world-wide. The students participate in discussions held by COE faculty members and invited guests on the topics outlined above. For the summer term of the forth year, students with the no COOP option must complete the summer training course COE 399. The aim of the summer training is to provide students with direct on-the-job experience working with professionals in the field. This training provides an opportunity to expose students to the reality of professional practice. Students are required to submit a report and make a presentation on their summer training experience and the knowledge gained.

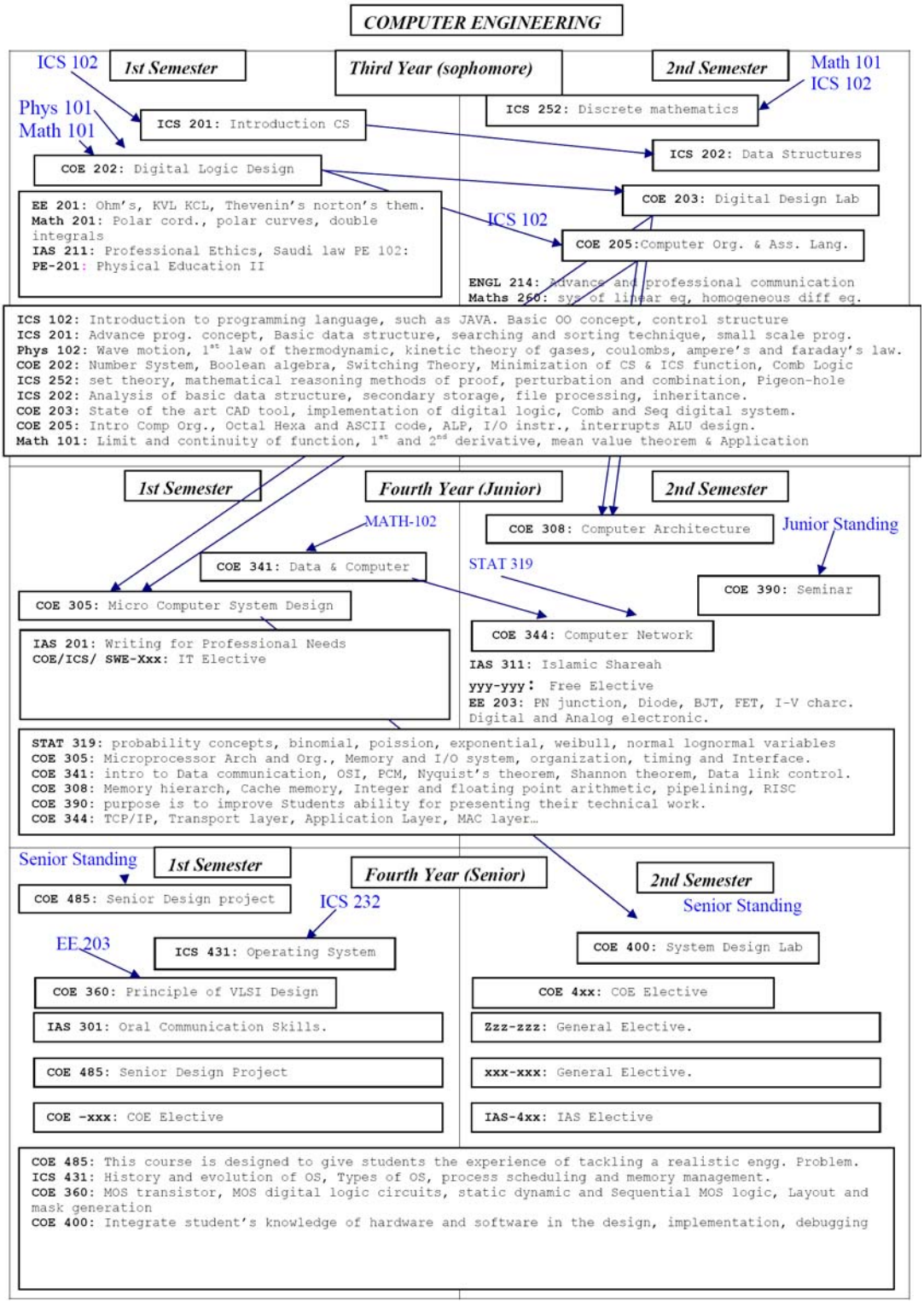
For the fifth year, students in the BS in Computer Engineering with the no COOP option must complete COE 485, COE 360, COE 400, and two 400 level elective courses COE 4xx. COE 360 introduces the principles of VLSI design and the covered topics include MOS transistor operation and limitations, MOS digital logic circuits (NMOS & CMOS), static & dynamic logic, and transistor sizing. MOS IC fabrication, layout and design rules, stick diagrams, IC Design and Verification Tools, subsystem design and case studies are amongst the topics covered as well. This course emphasizes the use of different CAD tools for the design and verification of digital integrated circuits. The course project is intended to build the students' ability to design, implement, and verify a digital integrated circuit. It also helps developing the student's ability to plan, work within a team and communicate his design efforts. The COE 485 is designed to give students the experience of tackling a realistic engineering problem. The intent is to show how to put theoretical knowledge gained into practical use by starting from a word description of a problem and proceeding through various design phases to end up with a practical engineering solution. Various projects are offered by COE faculty in their respective specialization areas. The project advisor guides the student in conducting a feasibility study, preparation of specifications, and the methodology for the design. Detailed design and implementation of the project are carried out followed by testing, debugging, and documentation. An oral presentation and a final report are given at the end of the semester. The COE 400, the capstone design project course for the B.Sc. degree in Computer Engineering, is a project-oriented course to integrate student's hardware and software knowledge through the design, implementation, debugging and documentation of one major system. This course represents the culmination of design, analysis, and implementation experience for students in our program. In addition to these courses students must select two elective courses COE 4xx in the area of their interest. The department offers a variety of elective courses in the areas of computer networks, digital systems design, computer architecture, robotics, etc.

The fourth year of the B.Sc. program in Computer Engineering with the COOP option is similar to that without the COOP option except for the ICS 324 which is typically completed before the COOP assignment starts. Furthermore, COE 360 is completed during the second semester of the fourth year rather than the first term of fifth year as

in the regular program. The students register in the COOP course COE 350 in summer and continue for the first (Fall) semester of the fifth year as COE 351. An alternative is to register COOP course in the second (spring) semester as the course COE 350 and continue it during the summer semester as COE 351. The former arrangement is the one depicted in the suggest plans above. Upon the return of the COOP interns the second semester is very similar to that for the no COOP option with the exception of less COE and general electives.

The courses COE 400 “embedded Systems” and COE 485 “Senior Design Project” represent a learning platform where knowledge and skills acquired across the COE program are culminating into a major design experience. Table 5.1-3 shows the culminating learning experience through the COE Program. The program courses is broken down into semesters and the flow-chart shows also the pre-requisite and co-requite edges.

Table 5.1-3. Culminating Learning Experience through the COE Program



Requirements for Bachelor of Science in Computer Engineering

The following subsections describe the program areas: (1) Basic Science, (2) Mathematics, (3) English, Physicals Education, Islamic Studies, and Humanities, (4) Information and Computer Science, (5) Electrical Engineering, (6) Information Technology, (7) Computer Engineering, (8) Capstone Project, (9) BS with COOP, and (10) BS without COOP.

Basic Sciences

In this area the students must complete three four-credit hour courses with laboratory for each course. The courses are General Chemistry (CHEM 101), General Physics 1 (PHY 101), and General Physics (PHY 102). CHEM 101 introduces the fundamental concepts of chemistry using both qualitative and quantitative approaches are introduced. The PHY 101 course covers topics related to particle kinematics and dynamics, rotational kinematics, rigid body dynamics, simple harmonic motion; the static, and dynamics of fluids. The course also emphasizes on basic physics laws such as conservation of energy and momentum. Finally, the PHY 102 focuses on topics related to wave motion and sound, temperature, first and second law of thermodynamics, kinetic theory of gases, Coulomb's law, the electric field, Gauss' law, electric potential, capacitors and dielectrics, D.C. circuits, the magnetic field, and Ampere's and Faraday's laws. It should be noted each of the three courses includes a laboratory where students carry out experiments in the respective fields to reinforce the covered material and more importantly equip students with experimental skills for further advanced courses.

Mathematics

Realizing the importance of this area, the program requires that students complete the following set of courses: Calculus I (MATH 101), Calculus II (MATH 102), Calculus III (MATH 201), Introduction to Differential Equations and Linear Algebra (MATH 260), and Probability and Statistics for Engineering and Scientists (STAT 319). The total number of credit hours in this area is 17 credit hours. MATH 101 and MATH 102 cover basic topics in calculus including continuity, differentiability, and integration of real-valued functions. In addition sequences and series are also covered. In MATH 201, more advanced topics such as polar, cylindrical, and spherical coordinate systems are utilized. Functions of two and three variables and related concepts such as partial and directional derivatives, and double and triple integrals are also covered. Finally, in STAT 319 the students are introduced to the subjects of presentation and interpretation of data, elementary probability concepts, random variables and probability distributions. The course also focuses on estimation, tests of hypotheses for one sample problem. It should be mentioned that STAT 319 includes a laboratory session where students perform problem solving using statistics software. The Information and Computer Science department provide us with a 3-credit course (ICS 252) on Discrete Structures.

English, Physicals Education, Islamic Studies, and Humanities

To complement the technical part of the COE program, the students are required to complete a minimum of 34 or 28 credit hours for a BS in Computer Engineering and B.Sc. in Computer Engineering with COOP, respectively. These credit hours span the sub-areas of English, Physical Education, Islamic Studies and Humanities, and General Electives. The courses in this area prepare the students with communication skills in both the English and Arabic languages, provide an introduction into human rights, ethics, and Shareeah in Islam. The PE courses also offer basic training in physical education. This non-technical supplement contributes significantly to the production of a well-rounded and well-informed graduate with societal, local and international, reflections.

Information and Computer Science Area

Students in the BS Computer Engineering program are required to complete five courses from the Information and Computer Science (ICS) department with four courses having associated laboratories. These courses amount to 18 credit hours. The courses intent is to provide the undergraduate with strong background in related computer sciences such as programming, data structures, discrete structures, and operating systems. The courses in this area are further detailed in the "Computer Science Component".

Electrical Engineering Area

Electric Circuits I (EE 201) and Electronics II (EE 203) are two required courses from the Electrical Engineering department for students enrolled in the BS Computer Engineering program. The EE 201 courses serve to give students the necessary and background in basic electrical circuit analysis while EE 201 serves to provide the needed background in semiconductor physics, digital electronics, analog electronics, and amplifiers. It is noted that EE 203 is a prerequisite for our COE 360 course.

Information Technology Area

In this area, students must select one of three courses: an elective course from the computer engineering department (COE 4xx), the Design and Analysis of Algorithms (ICS 352) course from the Information and Computer Science department, or the Introduction to Software Engineering (SWE 360) course from the Software Engineering department. This area allows the student to either broaden his knowledge and training in computer science and software field (e.g. ICS 352 or SWE 360) or provide in-depth education in a selected area in computer engineering (e.g. COE 4xx).

Computer Engineering Area

This area includes nine core COE courses, namely: Digital Logic Design (COE 202), Digital Logic Laboratory (COE 203), Computer Organization and Assembly Language (COE 205), Microcomputer System Design (COE 305), Computer Architecture (COE 308), Data and Computer Communications (COE 341), Computer Networks (COE 344), Principles of VLSI Design (COE 360), and Seminar (COE 390). An additional 400-level elective course (COE 4xx) is required in this area.

These courses, together with System Design Laboratory course (COE 400), represent the backbone of the BS in Computer Engineering program. The courses COE 202 and COE 203 server the digital systems design area, while COE 305 and COE 308 serve the computer architecture area. The area of computer communications and networking is served by COE 341 and COE 344, whereas COE 360 serves the electronics and VLSI area. The COE 390 course provides the students with the opportunity to improve their presentation skills in addition to emphasizing the various social and ethical responsibilities of the computer engineering profession. This area include 4 laboratories (COE 203, COE 205, COE 305, and COE 344) while the rest of the courses, for the exception of COE 390, contain significant design projects.

Capstone Project

The Systems Design Laboratory course (COE 400) represents one major design project course for the BS Computer Engineering program for all students (with and without COOP options) have to complete. Other design component exists in other COE courses as well. The COE 400 is a project-oriented course to integrate student's hardware and software knowledge through the design, implementation, debugging and documentation of one major system. In this course students are expected to work in teams to come up with a final working system where they learn to make design decisions weighing various engineering factors and tradeoffs, e.g. cost/performance, and hardware/software. More details on this capstone project course are included in section 5.3 (Design Experience Component).

B.Sc. in Computer Engineering with COOP

Students with the COOP option has to complete, in addition to the courses specified in the Common Stream for Computer Engineering, the following courses: Database Systems (ICS 324) and Cooperative Assignment (COE 350 and COE 351). The COOP program, represented by COE 350 and COE 351, is a continuous period of 28 weeks spent in industry with the purpose of acquiring practical experience in various areas of Computer Engineering. During this period, the student is exposed to the profession of Computer Engineering by working in the field and regularly interacting with his academic advisor through direct contact and meeting as well as through submission of an action plan, three progress reports, and a final COOP report. Most often the advisor provides feedback to the COOP student based on personal contacts and COOP progress reports. Students are required to submit a final report and deliver a presentation about the experience, knowledge, and engineering skills, gained during their Cooperative work. A COOP examination committee if formed by the COE COOP coordinator to evaluate the student presentation, various reports, and make overall evaluation decision on the COOP work.

B.Sc. in Computer Engineering

For the non COOP option, students have to complete, in addition to the courses specified in the Common Stream for Computer Engineering, the following set of courses: Summer Training (COE 399), Senior Design Project (COE 485), a 400-level elective course from the Computer Engineering department (COE 4xx), and two general non-Computer Engineering elective courses YYY and ZZZ. Students with this option can complete ICS 324 as an IT elective.

Computer Science Component

Computer Science has long been an essential component to the Computer Engineering curriculum, and we maintain close working relationships with the Information and Computer Science (ICS) department. There are common committees and common graduate programs between the Computer Engineering and the Computer Science departments at the Master and Ph.D. levels.

For the undergraduate program in Computer Engineering, there are five required ICS courses, four of which have dedicated laboratories associated with the respective courses, for a total of 12 Computer Science laboratory hours. The total Computer Science Component accounts for 18 credit hours, as shown in Table 5.1-4.

Table 5.1-4. Computer Science component in the COE program.

Course #	Title	Lecture	Lab	Credits
ICS 102	Introduction to Computing	2	3	3
ICS 201	Introduction to Computer Science	3	3	4
ICS 202	Data Structures	3	3	4
ICS 252	Discrete Structures I	3		3
ICS 431	Operating Systems	3	3	4
COE/ICS/SWE	IT Elective	3		3
	Total Computer Science Requirement	17	12	21

Depth in Computer Science is achieved through courses in programming, data structures, and operating systems. This sequence of courses combines a rigorous theoretical base with significant laboratory experience and provides students a rich experience and an appreciation of large-scale software systems.

The ICS 102 introduces the Java programming language and basic object-oriented programming concepts to freshmen-level students. In the lab, students exercise the use of the various features of object oriented programming taught in the course. This includes the implementation of basic applets.

The ICS 201 covers advanced programming concepts, graphical user interfaces, basic data structures, and searching and sorting techniques.

The ICS 202 covers the analysis of data structures, the specification and design of advanced abstract data types, garbage collection, secondary storage structures and files. It also introduces design patterns, and includes case studies and practice in developing medium scale programs. Emphasis is placed on frameworks and component architectures.

The ICS 252 covers topics including basics of propositional and predicate logic, set theory, and relations. It also covers mathematical reasoning and combinatorial analysis.

The Operating Systems course (ICS 431) covers processes, inter-process communication and synchronization, process scheduling, memory management, file systems, security, and protection. Case studies are covered from real operating systems.

In addition to the above required courses, many Computer Engineering students take the Database Systems course as an elective course, before going into summer training or COOP. Many students choose to take this course because it helps them in their working environment.

Design Experience Component

Design experience, particularly in large-scale projects, is central to the COE program. The COE 400 Digital System Design is a capstone design project course where knowledge and skills acquired from various components of the COE program are integrated into a structured design project. COE 400 is centered on building embedded systems from the hardware/software co-design perspective as well as introducing the RTOS environment. The methodology for building such systems is also taught in this course.

The IEEE/ACM body of knowledge in Computer Engineering has been used as a model in the design of COE 400 as a platform for the integration of the major computer engineering modules introducing (1) embedded systems, (2) computer system engineering hardware and software, and (3) operating systems. The course starts with an introduction on microcontrollers and microcontroller-based systems; direct programming, introduces Real Time Operating Systems, and finally presents standard interfaces and their usage. COE 400 exposes the student to development at high-level programming construct as well as at assembly language programming. Even-driven practice is developed through the programming interrupt handling procedures.

The COE-400 is a project-oriented course where students focus on the design, development and management of an entire project as a group with all what this implies. Students also learn how to use microcontrollers and build microcontroller applications. This course presents an embedded processor and its software development system.

COE 400 exposes the students to teamwork through working in groups of no more than 5 students. A leader is assigned to each team.

Each semester COE 400 exposes the students to an open-ended (problem-based) design project of a complexity that is adjusted to cover one full semester of work at the senior level. The student team is expected to deliver the following sequence of requirements: (1) a specification report describing the product, (2) a task description report describing how the project tasks are distributed over the team members and the allotted time for each task, (3) a design report describing the proposed solution to the problem, discussing its technical and cost aspects, and its feasibility constraints in time and resource, (4) an implementation and testing report describing the implementation details, debugging, testing, and evaluation.

The Computer Engineering option (No COOP) allows the student to develop the depth or specialization in the discipline by taking the Senior Design Project course (COE 485) and getting more exposure to COE electives. The senior design project

allows further refinements of the engineering design component and the integration skills culminating in the Digital System Design (COE 400). In addition, the student is offered a wider exposure to the general electives such as courses from EE, Math, Management, Marketing, etc.

The Computer Engineering with the COOP option provides the COE student real-life Cooperative professional development. During 8 months (Spring with Summer or Summer with Fall) the students engage in a Saudi or International company while being assigned an academic COOP advisor in addition to an industry COOP supervisor. The student is exposed to the profession of computer engineering in the industry through its multidisciplinary teams and wider engineering perceptive. In addition to a COOP plan the student is required to carry out extensive written communication assignments (three progress reports and final report) and communicate with his academic advisor as well as with the COOP academic coordinator. The COOP student returning from COOP brings an innovative and global perception of computer engineering profession which guides him in finishing his engineering education and deciding about his future career.

General Education Component

The General Education component is well focused and complements the technical component to achieve the program educational outcomes and program educational objectives of the Computer Engineering program.

The general education courses cover the following areas: English (9 Credits), Arabic studies (6 Credits), Islamic/humanities studies (8 Credits), and Physical Education (2 Credits), a total of 25 credits. In addition to these areas, non-COOP computer engineering program students are required to complete three free elective courses (9 Credits) while the COOP computer engineering program students are required to complete one free elective course (9 Credits), i.e. 34 credit hours or 28 credit hours of general education courses for non-COOP program and COOP program options, respectively. The curriculum for the Computer Engineering program consists of 130 or 131 credit hours for non-COOP program and COOP program options, respectively.

The courses contributing directly to the General Education component are listed in Table 5.1-5. We are aware that the Physical Education courses are not part of the General Education component. The mission of the 15-course general education curriculum at King Fahd University of Petroleum and Minerals is twofold: to nurture the formation of the undergraduate student as a thinking and caring citizen of the world of today, and to provide the general educational advanced intellectual technical “major” field of study.

Table 5.1-5. General Education Component

Communications (English)	1	ENGL 101	Introduction to Academic Discourse	3 credits	
	2	ENGL 102	Introduction to Report Writing	3 credits	
	3	ENGL 214	Academic and Professional Communication	3 credits	

			Subtotal credit hours		**9**
Communications (Arabic)	4	IAS 101	Practical Grammar	2 credits	
	5	IAS 201	Writing for Professional Needs	2 credits	
	6	IAS 301	Language Communication Skills	2 credits	
			Subtotal credit hours		**6**
Islamic/Humanities	7	IAS 111	Belief and its Consequences	2 credits	
	8	IAS 212	Professional Ethics	2 credits	
	9	IAS 322	Human Rights in Islam	2 credits	
	10	IAS 4xx	IAS Elective	2 credits	
			Subtotal credit hours		**8**
Physical Education	11	PE 101	Physical Education I	1 credit	
	12	PE 102	Physical Education II	1 credit	
			Subtotal credit hours		**2**
General Electives	13	XXX xxx	Free Elective I*	3 credits	
	14	XXX xxx	Free Elective II*	3 credits	
	15	XXX xxx	General Elective	3 credits	
			Subtotal credit hours		**9 (3)**
			Total General Education	**34 credits**	**34 (28)**

* Only for "BS in Computer Engineering" (No COOP) program option.

It should be noted that the General Education component courses are university requirements and are common for all programs within KFUPM. The component attempts to integrate a broad education in the areas of Communication, Islamic and Humanities, and Physical Education with each student's major area of study.

The General Education component courses can be classified into the following subcomponents:

- Communication Skills subcomponent: In this track, Computer Engineering students are required to complete three courses (ENGL 101, ENGL 102, and ENGL 214) with 9 credit hours of English language focusing on composition, technical writing, and communication skills. These courses are offered by the English department. In addition, three more courses (IAS 101, IAS 201, and IAS 301) with 8 credit hours focus on writing, literary studies, and communication skills in Arabic language The latter three courses are offered by the Islamic and Arabic Studies Department.
- Islamic/Humanities subcomponent: A total of 4 courses with 8 credit hours are required from Computer Engineering students in this subcomponent. These courses are offered by the Islamic and Arabic Studies department in the College of Applied and Support Studies. Three courses, each worth 2 credit hours, include IAS 111, IAS 212, and IAS 322. IAS 111 highlights the characteristics of the Islamic faith and its view of the universe, human beings and life. The importance and guidelines of ethics in Islam and in general are the focus of IAS 212. The course also presents a perspective on professional ethics and employer-employee relationship as specified in the governmental regulation of Saudi Arabia. The focal point for IAS 322 is the nobility of

human and human rights in Islam and its uniqueness. The basic human rights are also detailed in this course. In addition to the above three courses, the students are required to select a fourth 400-level course from the Islamic and Arabic Studies department to supplement this subcomponent. It should be mentioned that for students of non-Muslim faith, the programs allows the substitution of previous by courses in the area of Social and Behavioral Sciences. Finally, in regard to the professional ethics topic, the Computer Engineering program includes a core course COE 390 Seminar of 1 credit hour focusing also on communication and presentation skills. The course also details the ethics codes and guidelines for professions relevant to computing in and those for engineering in general.

- Physical Education subcomponent: All students are required to complete two courses PE 101 and PE 102, with 1 credit hour for each course, as part of the core curriculum.
- General Elective subcomponent: This track includes three courses for non-COOP Computer Engineering students or one general elective course for COOP program Computer Engineering students. The course can belong to any department to promote broader education.

5.2. Prerequisite Flow Chart

Figure 5.2-1 and Figure 5.2-2 represent the COE Program Flow-Chart for the BSc Without COOP and BSc With COOP, respectively.

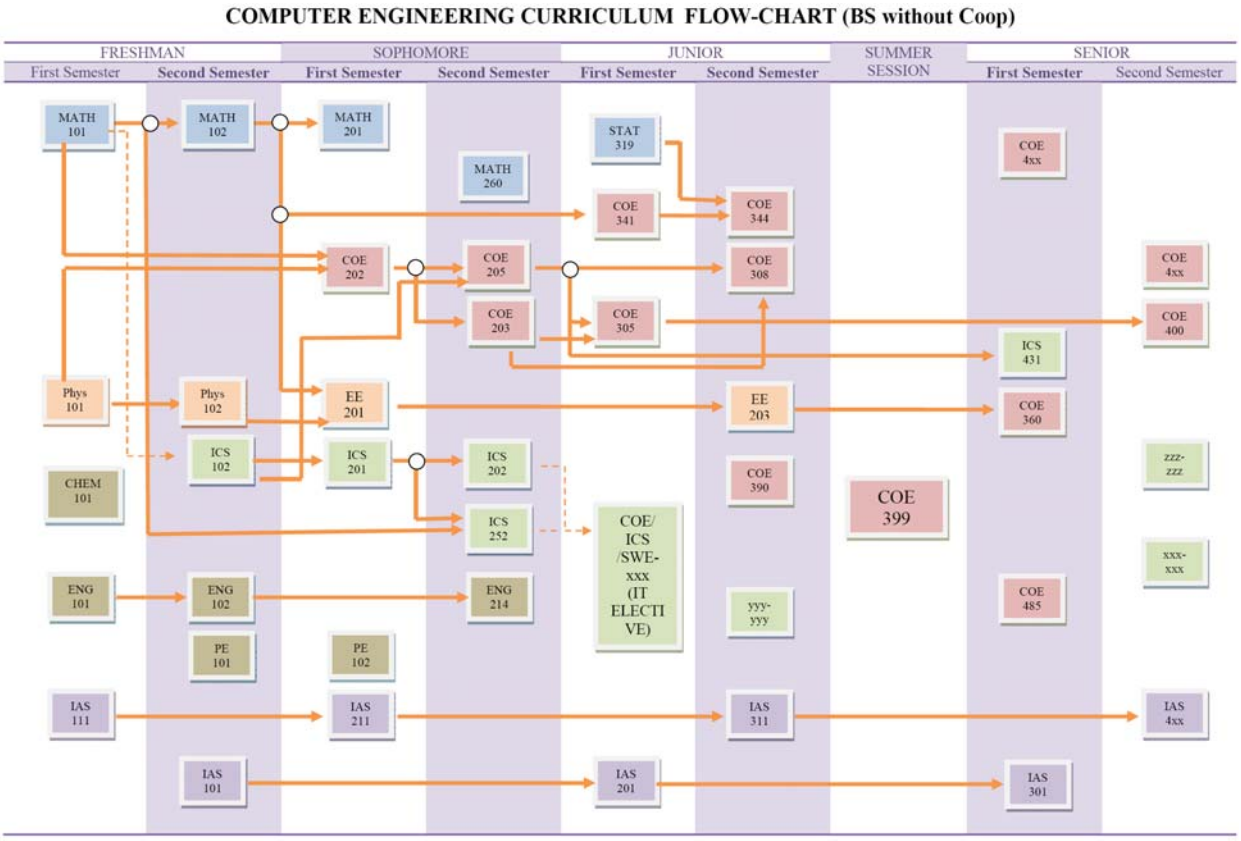


Figure 5.2-1. COE Program Flow-Chart for the BSc without COOP.

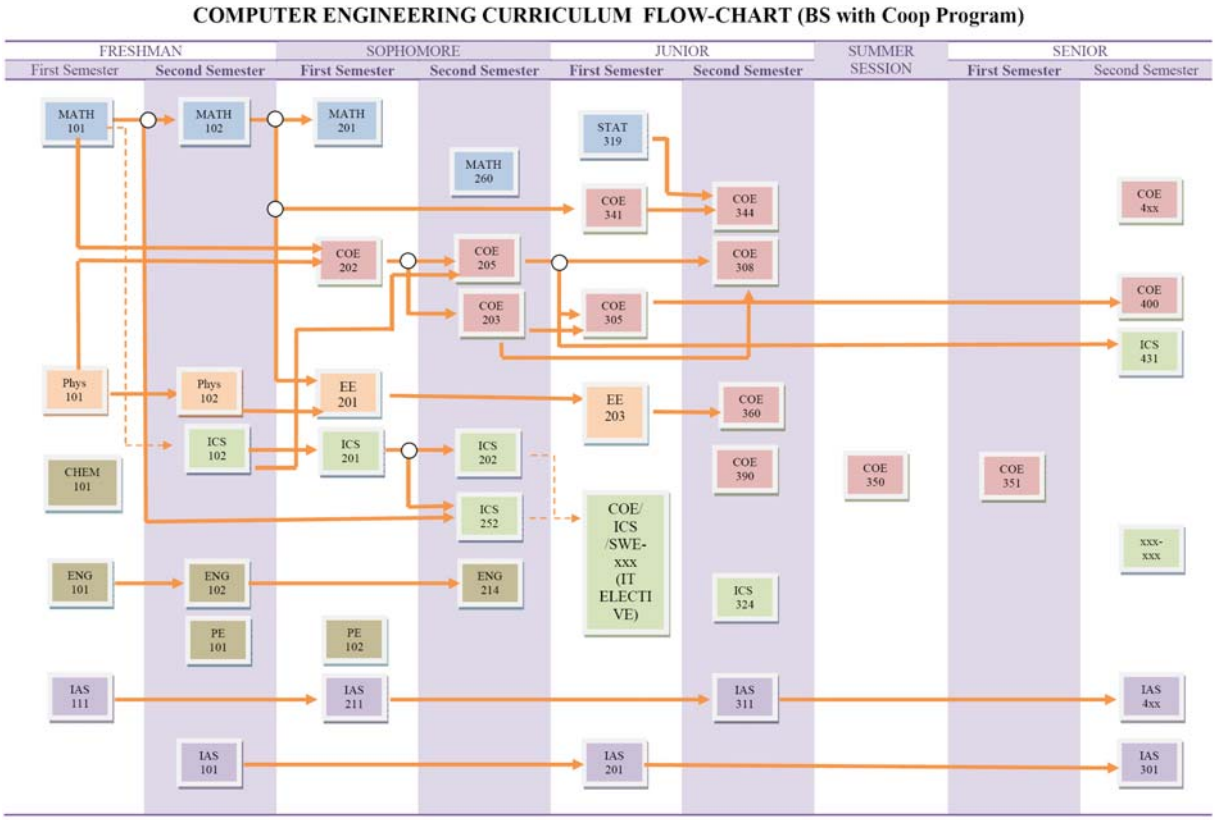


Figure 5.2-2. COE Program Flow-Chart for the BSc with COOP.

5.3. Course Syllabi

In Appendix A we present the list of syllabi for each core course.

CRITERION 6. FACULTY

6.1. Leadership Responsibility

The chairman of the Computer Engineering Department exercises the leadership responsibilities for the program. All matters and requests regarding the Computer Engineering Program are directed to the chairman. The COE chairman manages the program with the help of the department standing committees listed in Table 0.4-1 which provides a description of duties and responsibility of each committee. Other ad hoc committees are formed by the chairman as necessary to deal with matters of temporary nature. The chairman directs various issues related to the program to the relevant standing committee. The committee meets and takes necessary action or makes recommendations. Where required, such recommendations are discussed in the COE Department Council and are then reported to the Dean and the council of the CCSE college for approval.

6.2. Authority and Responsibility of Faculty

The COE faculty are committed to the program development and course coverage in addition to maintaining continuity and improvement of academic standards. The interest and qualifications of department faculty members are sufficient to plan, teach, modify and update all offered COE courses, and curriculum. The COE faculty collectively present an impressive level of competence in their respective areas of specialty through their academic, research and industrial experiences.

There are four major curricular groups covering the major areas in the undergraduate program at the COE department. These are:

1. Computer networks and data communications,
2. Computer architecture and organization,
3. VLSI and digital systems design,
4. Computer applications.

Each COE faculty member is a member in one or group according to his specialization. The faculty member who initiates a new course or course modification has to present it first to the group. The group meets and discusses such a new course or modification to an existing course and comes up with recommendations on the matter. The group recommendations go to the department council for approval and then to the collage council afterwards. They finally have to be approved by the university scientific council.

To ensure course quality, every instructor has to submit a course file by the end of the

semester. This course file includes: quizzes, homework assignments, major and final exams, handouts, best and worst examples of student work, as well as any other materials related to the course. The course file also includes all student surveys, course outcome assessments, and rubric assessments related to the course.

6.3. Faculty

The COE department has currently 28 full time faculty members. For all COE faculty, Table 6.3-1 lists the courses taught in the two terms of the academic year 2008/2009 and the percentage distribution of the faculty activities in teaching, research, and other assignments.

Table 6.3-1. Workload Summary of COE Faculty

Faculty Member	FT or PT[4]	Program Classes Taught (Course No./Credit Hrs.) in 2008/2009		Total Activity Distribution[2]		
		Term 081	Term 082	Teaching, %	Research/ Scholarly Activity, %	Other[3], %
Dr. Adnan Gutub	FT	COE 449/3		10	20	70 Department Chairmanship Administration
Dr. Mayez Al-Mouhamed	FT	COE 202/3 COE 541/3	COE 484/3 COE 501/3 COE 584/3	50	20	30
Dr. Radwan Abdel-Aal	FT	COE 202/3 COE 305/3	COE 202/3 COE 305/3	65	20	15
Dr. Sadiq Mohammed Sait	FT	COE 202/3	--	25	25	50
Dr. Aiman El-Maleh	FT	COE 561/3 ICS 233/3	COE 203/1 COE 205/3	40	40	20
Dr. Alaaeldin Amin	FT	COE 202/3 COE 360/3	COE 360/3 COE 586/3	40	40	20
Dr. Muhammed Elrabaa	FT	COE 202/3	COE 203/2 COE 390/1	50	50	-
Dr. Abdul-Hafid Bouhraoua	FT	COE 205/3 COE 400/1 COE 485/1	COE 390/1 COE 400/1 COE 409/3 COE 599/1 CSE 699/1	50	30	20
Dr. Ahmad Almulhem	FT	--	COE 203/2	65	35	-
Dr. Ahmad Al-Yamani	FT	--	--	Deputation		

Dr. Ashraf Mahmoud	FT	COE 202/3 COE 540/3	COE 341/3 COE 543/3	50	30	20
Dr. Atef Al-Najjar	FT	COE 441/3	COE 441/3	50	30	20
Dr. Basem AlMadani	FT	COE 390/1 COE 499/3 COE 599/1 CSE 699/1 ICS 490/3	COE 485/3 COE 504/3			
Dr. Marwan Abu-Amara	FT	COE 202/3 COE 341/3	COE 344/3 COE 540/3	40	30	30
Dr. Mohammed Sqalli	FT	CSE 552/3 CISE 301/3	COE 444/3 ICS 233/3	50	20	30
Dr. Muhamed Mudawar	FT	COE 202/3 COE 308/3	COE 308/3 CISE 301/3	50	20	30
Dr. Talal Alkharobi	FT	COE 591/3	CSE 551/3			
Dr. Tarek Sheltami	FT	COE 446/3 COE 485/1	COE 499/3 COE 549/3	50	20	30
Dr. Uthman Baroudi	FT	COE 344/3 CISE 301/3	COE 540/3 CISE 301/3	40	45	15
Dr. Zubair Baig	FT	--	COE 202/3 COE 203/1	50	50	-
Dr. M.W. Raad	FT	COE 202/3 COE 429/3	COE 202/6 COE 485/3	50	20	30
Mr. Bambang Sarif	FT					
Mr. Hakim Adiche	FT	COE 344/1 PYB 002/2	COE 344/2 PYP 002/2 ICS 343/3	50	20	30
Mr. Hazem Selmi	FT	COE 353/3 COE 400/1	COE 203/1 COE 353/3 COE 400/2	70	20	10
Mr. Kamel Chenaoua	FT	COE 203/2 COE 205/1 ICS 233/1	COE 203/1 COE 205/2 COE 233/1	50	20	30

Mr. Masud Ul-Hasan	FT	COE 305/1 PYB 002/4	COE 203/1 COE 305/1 PYP 002/2	100	-	-
Mr. Yau Isa	FT	--	--			

1 Indicate Term and Year for which data apply (the academic year preceding the visit).

2 Activity distribution should be in percent of effort. Members' activities should total 100%.

3 Indicate sabbatical leave, etc., under "Other."

4 FT = Full Time Faculty PT = Part Time Faculty

Table 6-2 lists the rank, type of academic appointment, highest academic degree with the awarding institution and year, number of years of the various types of experience, and information on levels of professional activities.

The table indicates that 21 out of the 27 COE faculty have doctorate degrees (78%). 67% of the 21 PhD holders obtained their degree from universities in the USA and Canada. 29% obtained their degrees from university in the UK, Europe and Australia. The distribution of the full-time faculty ranks is as follows: three professors, four associate professors, twelve assistant professors and seven lecturers, in addition to one assistant professors who is currently on deputation to other government institutions in the kingdom.

Out of the 20 COE faculty in professorial ranks, 7 faculty have industrial experience averaging around 4.6 years per faculty. COE faculty have an average teaching experience of around 13.5 years per faculty. Over the term 082 of the academic year 2008/2009, overall average teaching load per faculty was around 5.1 credit hours.

6.4. Faculty Competencies

Table 6.4-1 and Table 6.4-2 list all COE faculty members, giving the academic rank, areas of specialization, and the curricular areas of the program covered by each. Brief resumes for all faculty members are included in Appendix B. The number of faculty providing teaching support for the above four curricular areas are 15, 14, 9, and 16, respectively. About 15 faculty members cover each of areas 1, 2, and 4. Area 3 (VLSI and Digital Design) is covered by 9 faculty members. This shows that the number of faculty in each area of specializations adequately cater for the requirements of the four major program areas and meet the quality standards expected for the COE program.

Table 6.4-1. COE Faculty Analysis

Faculty Member	Rank	Type of Academic Appointment (TT, T, NTT)	FT or PT	Highest Degree and Field	Institution from which Highest Degree Earned & Year	Years of Experience			Professional Registration/ Certification	Level of Activity (high, med, low, none) in:		
						Govt./Industry Practice	Total Faculty	This Institution		Professional Society	Research	Consulting /Summer Work in Industry
Dr. Adnan Gutub	Associate Professor	TT	FT	PhD, Electrical & Computer Engng.	Oregon State University, USA, 2002	--	15	15		Low	Low	None
Dr. Mayez Al-Mouhamed	Professor	NTT	FT	PhD. Electrical Engineering	Paris XI University, France, 1982	2	27	27		Low	Med	Low
Dr. Radwan Abdel-Aal	Professor		FT	PhD. Electrical & Electronic Engng	Strathcyde University, UK, 1983	4	24	24		Low	Med	Low
Dr. Sadiq Mohammed Sait	Professor		FT	PhD. Electrical Engineering	KFUPM, 1986	--	30	30		Low	Med	Low
Dr. Aiman El-Maleh	Associate Professor	NTT	FT	PhD. Electrical Engineering	McGill University, Canada, 1995	--	12	12		Low	Med	Low
Dr. Alaaeldin Amin	Associate Professor	NTT	FT	PhD. Computer Engineering	University of Utah, USA, 1987	8	22	22		Med	High	Low
Dr. Muhammed Elrabaa	Associate Professor	NTT	FT	PhD, Electrical & Computer Engng.	University of Waterloo, Canada, 1995	--	15	9		None	Med	None
Dr. Abdul-Hafid Bouharaoua	Assistant Professor	NTT	FT	PhD. Computer Engineering	University of Paris, France, 1998	6	5	5		Low	Med	Low
Dr. Ahmad Almulhem	Assistant Professor	TT	FT	PhD, Electrical & Computer Engng.	University of Victoria, Canada, 2007	--	16	16		Low	Med	Low
Dr. Ahmad Al-Yamani	Assistant Professor	TT	FT	PhD. Electrical Engineering	Stanford University, USA, 2004	--	13	13		Low	Med	Low
Dr. Ashraf Mahmoud	Assistant Professor	NTT	FT	PhD, Systems and Computer Engineering	Carleton University, Canada, 1997	5	8	8		Low	Med	Low

Dr. Atef Al-Najjar	Assistant Professor	TT	FT	PhD, Computer Engineering	Purdue University, USA, 1993	2	20	20		Low	Med	Low
Dr. Basem AlMadani	Assistant Professor	TT	FT	PhD, Industrial Automation	Montan University Leoben Leoben, Austria, 2005	--	2	2		Low	Med	Low
Dr. Marwan Abu-Amara	Assistant Professor	NTT	FT	PhD, Electrical & Computer Engng.	Texas A&M University, USA, 1995	8	7	7		Low	Med	Low
Dr. Mohammed Sqalli	Assistant Professor	NTT	FT	PhD, Engng – Systems Design	University of New Hampshire, USA, 2002	--	8	8		Low	Med	Low
Dr. Muhamed Mudawar	Assistant Professor	NTT	FT	PhD. Computer Engineering	Syracuse University, USA, 1993	--	15	6		Low	Med	Low
Dr. Talal Alkharobi	Assistant Professor	TT	FT	PhD. Computer Engineering	Texas A&M University, USA, 2004	--	17	17		Low	Med	Low
Dr. Tarek Sheltami	Assistant Professor	NTT	FT	PhD, Electrical & Computer Engng.	Queens University, Canada, 2003	--	7	6		Low	Med	Low
Dr. Uthman Baroudi	Assistant Professor	NTT	FT	PhD. Electrical Engineering	Concordia University, USA, 2000	2	8	8		Med	High	Low
Dr. Zubair Baig	Assistant Professor	NTT	FT	PhD, Computer Science	Monash University, Australia, 2008	--	1	1		Med	High	None
Dr. M.W. Raad	Lecturer	NTT	FT	PhD. Electrical & Electronic Engng.	University of Bradford, UK, 2005	--	24	24		Low	Med	Low
Mr. Bambang Sarif	Lecturer	NTT	FT	MSc, Computer Science	KFUPM, 2003	--	8	8		Low	Med	Low
Mr. Hakim Adiche	Lecturer	NTT	FT	MSc, Computer Science	KFUPM, 1997	--	12	12		Low	Low	Low
Mr. Hazem Selmi	Lecturer	NTT	FT	MSc, Electrical Science	KFUPM, 2000	--	9	9		Low	Low	Low
Mr. Kamel Chenaoua	Lecturer	NTT	FT	MSc, Electrical Engineering	University of Hull, UK, 1989	--	10	10		Low	Med	Low
Mr. Masud Ul-Hasan	Lecturer	NTT	FT	MSc, Computer Science	KFUPM, 1993	1	20	20		Low	Low	Low
Mr. Yau Isa	Lecturer	NTT	FT	MSc, Computer Science	KFUPM, 2003	--	8	8		Low	Low	Low

Table 6.4-2. COE faculty showing areas of specialization and curricular program area(s) covered.

1 = Computer networks and data communications, 2 = Computer architecture and embedded systems, 3 = VLSI and digital systems design, 4 = Computer applications, (e.g. neural networks, fault tolerant computing, etc.)

No	Name	Academic Rank	Areas of Specialization	Curricular Area(s) Covered			
				1	2	3	4
1	Dr Adnan Abdul-Aziz Gutub	Chairman, Assoc. Prof.	Modeling, Simulating and Synthesizing VLSI Hardware for computer arithmetic operations.			•	•
2	Dr Mayez Al-Mouhamed,	Professor	Computer Architectures, Parallel Processing and Algorithms, Computer Networks, Robotics, and Computer Vision.	•	•		•
3	Dr Radwan Abdel-Aal	Professor	Machine learning and data mining applications, Data acquisition and analysis for nuclear physics, Microcomputer system design, Testing of digital systems	•	•		
4	Dr Sadiq Sait Mohammed	Professor & Director, ITC	VLSI Design Automation, High Level Synthesis, Hardware Languages, ASIC Design, Heuristics, and Iterative Algorithms.		•	•	•
5	Dr Aiman El-Maleh	Asso. Prof.	Synthesis and Testing of Digital Systems, Design of Reliable Systems, Interconnect Efficient Low Density Parity Check Code Design			•	•
6	Dr Alaaeldin A. Amin	Asso. Prof.	VLSI Design and Testing. Computer Arithmetic, Cryptographic Hardware, and Asynchronous Design.			•	•
7	Dr. Muhammed Elrabaa	Asso. Prof.	VLSI, Digital Circuit Design, Mixed Analog-Digital Circuits. Reconfigurable Computing, Networks-on-Chip, Systems-on-Chip.			•	
8	Dr. Abdul-Hafid Bouharaoua	Asst. Prof.	Computer Architecture and Digital Systems		•		
9	Dr. Ahmad Almulhem	Asst. Prof.	Network Security, Network Forensics, Intrusion Detection Systems, Vulnerability Analysis, Malwares, Auditing, Fingerprinting, Application of Data Mining and Visualization techniques in Network Security.	•			•

Table 6.4-2. COE faculty showing areas of specialization and curricular program area(s) covered.

1 = Computer networks and data communications, 2 = Computer architecture and embedded systems, 3 = VLSI and digital systems design, 4 = Computer applications, (e.g. neural networks, fault tolerant computing, etc.)

No	Name	Academic Rank	Areas of Specialization	Curricular Area(s) Covered			
				1	2	3	4
10	Dr Ahmad A. J. Al-Yamani (on deputation to Sagia)	Asst. Prof.	VLSI Design and Test, Computer Aided Design Automation, Reliable Computing, Iterative Heuristics, and Computer Networks.	•		•	
11	Dr Ashraf Mahmoud	Asst. Prof.	Simulation/Modeling/Performance Evaluation of Wireless/Data Networks.	•			
12	Dr Atef Al-Najjar	Asst. Prof.	Parallel, Distributed and Intelligent Computer and e-Education Systems, Multi Media.		•		•
13	Dr Basem AL-Madani	Asst. Prof.	Industrial Automation, Systems Integration, Real-Time systems Distributed systems, Middleware software	•	•		•
14	Dr Marwan Abu-Amara	Asst. Prof.	Networking, Wireless and Mobile Computing, Parallel and Distributed Systems, Fault-Tolerance and Reliability.	•			•
15	Dr. Mohammed Sqalli	Asst. Prof.	Network Design and Management, Traffic Engineering, Iterative Heuristics, Constraint and Case Based Reasoning.	•			•
16	Dr Muhamed Mudawar	Asst. Prof.	Processor Micro architecture, Parallel Architectures and Interconnection Networks, Compilers.		•		•
17	Dr Talal Al-Kharobi,	Asst. Prof.	Information security, design automation, neural networks.		•		•
18	Dr Tarek Sheltami	Asst. Prof.	Wireless ad hoc, sensor and WiMax networks, Performance evaluation of wireless communication Protocols, VoIP in wireless networks	•			
19	Dr Uthman Baroudi	Asst. Prof.	Computer Networks, Wireless Networking and Radio Resource Management, Wireless sensor networks.	•			
20	Dr Zubair Baig	Asst. Prof.	Information and Network Security, Fault Tolerance, Distributed Systems, Pattern Recognition, Online Fraud Detection, Computer Architecture	•	•	•	•

Table 6.4-2. COE faculty showing areas of specialization and curricular program area(s) covered.
1 = Computer networks and data communications, 2 = Computer architecture and embedded systems, 3 = VLSI and digital systems design, 4 = Computer applications, (e.g. neural networks, fault tolerant computing, etc.)

No	Name	Academic Rank	Areas of Specialization	Curricular Area(s) Covered			
				1	2	3	4
21	Dr Muhammad Wasim Raad	Lecturer	Real time Digital signal processing, Embedded systems Design, Smart Cards & RFID.		•		•
22	Mr Bambang Sarif	Lecturer	Logic synthesis, fault tolerant computing, iterative heuristics, and swarm intelligence			•	•
23	Mr Hakim Adiche	Lecturer	Computer networks, network services, routing and switching algorithms, fast switching architectures, quality of services, and redundant and fault tolerant network architectures.	•			•
24	Mr Hazim Selmi	Lecturer	Digital Communication. Channel Coding. Error Control.	•	•		
25	Mr Kamal Chenaoua	Lecturer	Color Image Processing. Pattern recognition and classification.	•	•		
26	Mr Masud-ul-Hassan	Lecturer	Embedded Systems, Microcontroller System Design, Digital System Design, FPGA Based Synthesis, `Digital System Testing`, VLSI Design, Computer Aided Design Automation,		•	•	
27	Mr Ya'u Isa Garba	Lecturer	Computer networks, systems performance analysis and evaluation, embedded systems	•	•		
			Total	**15**	**14**	**9**	**16**

6.5. Faculty Size

In the spring term of the academic year 2008/9, 21 faculty members delivered 17 lecture courses to 384 undergraduate students in 22 sections and four laboratory courses to 251 students in 17 sections. In addition to COE students, this number includes students from other KFUPM departments, e.g. electrical engineering, for which the COE department is teaching COE 202 and COE 203 courses as service courses. The average number of students per section was 17 for lectures and 15 for

labs. The overall average of the number of sections per faculty was 1.9. With a total enrolment of 257 COE students for that semester, the COE student-to-faculty ratio was 11.7:1. This shows the adequacy of faculty size for the offered program and the student population.

COE faculty members have a wide range of responsibilities in addition to teaching, including other student-faculty interaction, student advising and counseling, research activities, professional services, professional development, and interaction with industry.

The COE faculty members dedicate at least 6 office hours per week to helping and consulting the advisees. The faculty members also interact with students through the activities of student clubs such as the computer club, the IEEE and IET student branches at KFUPM, and in regular series of research seminars. Life in the University campus allows other avenues of interaction through social, sports, and leisure activities. The college of CCSE organizes an annual dinner meeting attended by the Dean and Department Chairmen, faculty, and the students to discuss issues of mutual concern. Student-faculty communication is most often carried out via e-mail and discussion forums on the course WebCT site have increased significantly over the past few years. Moreover, the department adopts a formal academic advising scheme where every faculty advises about 20 COE students on average and provides academic guidance and consultation. The faculty members are always available to provide guidance and to advise students during the pre-registration and registration days and dedicate one office day to answer student queries in person after posting final grades at the end of the semester.

The faculty member actively pursues research in their area of specialization. In addition to personal research efforts, they utilize many avenues available for funding at KFUPM as well as external funding by industry and research funding national agencies. During the academic year 2007/8 COE faculty were engaged in 29 funded research projects, out of which 8 projects were completed during the year. During the same year, faculty members produced 6 patents and a total of 49 research publications, of which 20 were in refereed journals. A total of 10 technical reports were also authored by faculty in the same period. Faculty also contributed 19 research seminars and 3 short courses. Research work by faculty members was cited over 96 times in the open literature during the year.

Professional services provided by faculty members include contributing to university, college, and department committees which focus on enhancing the academic programs and their outcomes, improving the welfare of the students and faculty, and increasing interaction between the University and the surrounding community and industry. During the academic year 2007/8, faculty members contributed to 18 university, 7 college, and 23 department committees. In addition, faculty supervised 28 senior design projects completed by 35 students, 9 COOP training projects completed by 9 students in 5 companies, as well as 38 summer training students.

Faculty members have also supervised 1 PhD and 4 Master theses to completion during the same year.

6.6. Faculty CVs

Appendix B includes abbreviated resumes of the COE faculty in the required format. CV's are given according to the required format.

6.7. Faculty Development

Faculty members utilize the wide range of opportunities offered by KFUPM for professional development. The university provides funds to support scientific research by faculty through a variety of research grant schemes managed by the Deanship for Scientific Research (DSR). During the academic year 2005/6, COE faculty secured 3 new SABIC/Fast Track research grants with a total value of SR 212,000 and one junior faculty research grant of SR 50,000. Faculty were also granted SR 225,000 for attending 4 national and 20 international research conferences in their areas of specialization. Other support is available for book writing and translation and for the development of online courses. A senior faculty can also apply for university support for one-semester sabbatical leave of absence to pursue research of his choice at a reputable academic/research institution. Faculty may also benefit from summer research grants offered by professional societies abroad.

Faculty members pursue academic development as educators through extensive programs offered by the Deanship of Academic Development (DAD) at KFUPM, with special programs designed to help junior faculty. DAD's Teaching & Learning Centre (TLC): promotes excellence in teaching and student learning both inside and outside the classroom through organizing workshops, mini-courses, seminars, consulting services, academic development grants, and peer consultation programs. The Program Assessment Center (PAC) focuses on programs rather than on individuals, determining how they contribute to student growth and development. It provides information on whether the curriculum as a whole provides students with the knowledge, skills and values that graduates should possess to satisfy the stated mission, goals and learning objectives. The e-Learning Center (ELC) promotes quality self-paced, learner-centered education through the development and delivery of quality web-based courses delivered completely online and assists KFUPM faculty in developing interactive web-based supplementary material aimed at enhance teaching and learning effectiveness of traditional courses. The Testing & Evaluation Center (TEC) provides support and training in test construction and validation, meant to provide further stimulus for active learning and objectives-based instruction. The study and evaluation of faculty performance indicators represent other major concerns for the Center.

The KFUPM Research Institute provides an interface for proposing and managing contractual research with industry. Further interaction with industry takes place

through industry-funded projects, teaching in short courses for industry organized by KFUPM, the COOP program, student summer training, the career day, contacts with COE alumni, visits, and attending meetings of professional societies, workshops, and technical exchange meetings. During the academic year 2007/8, COE faculty contributed to 3 short courses and supervised 9 students who completed their COOP programs in 5 companies and organizations. The department has established an industry advisory board to help evaluate the curriculum and ensure relevance to the local job market. The board met with the COE faculty for the first time on 25 April, 2007 and the second meeting took place on 31 May 2009.

Faculty members are motivated to excel through a promotion scheme that takes into account performance in teaching, research, and services. The university faculty promotion guidelines follow international standards in the education profession. Faculty promotion is based on peer evaluation done by external reviewers. Moreover, a number of university awards exist for outstanding faculty performance, including the Excellence in Teaching Award, Excellence in Research Award, and Excellence in Multidisciplinary Research, Excellence in Advising Award, and Excellence in Coordinating Short Courses. The college also offers similar awards. Many COE faculty members have won several of such awards over the years.

King Abdul Aziz City for Science and Technology (KACST), a major research funding institution in the kingdom, offers a nation wide Excellence in Research Certificate. In 2006-2007 one COE faculty member won the first order, golden Excellence in Research Certificate for a research project on Telerobotics.

Faculty professional development efforts represent a prime objective of KFUPM administration and are manifested in the following two areas:

1. Academic Development, Which is administered by the Deanship of Academic Development.
2. Research Development, which is administered by the Deanship of Scientific Research.

Funding allocated by the University is adequate for the needs of both deanships. The Deanship of Academic Development operates the following centers which cater for various aspects of academic development of faculty:

1) Teaching & Learning Centre (TLC): This center promotes excellence in teaching and student learning both inside and outside the classroom. TLC activities include workshops, mini-courses, seminars, consulting services and resources to faculty and graduate teaching assistants to enhance teaching and learning. The TLC also administers several special programs including academic development grants and a scheme for peer teaching consultation to faculty members.

2) Program Assessment Center (PAC): This center is concerned with how educational programs are working and their contribution to student growth and development, focusing on programs rather than individuals. It provides information on whether the curriculum as a whole provides students with the knowledge, skills and values that graduates should possess in accordance with its mission and set goals and learning objectives.

a) **e-Learning Center (ELC):** The e-Learning Center assists the University community in exploiting the potential of new information and instructional technology to enhance teaching and learning. The center promotes quality self-paced, learner-centered education through the development and delivery of web-based courses that can be delivered completely online. The center also helps KFUPM enhance teaching and learning effectiveness through the development of interactive web-based supplementary material to traditional courses and organizing seminars and training workshops on the development and delivery of online material.

3) Testing & Evaluation Center (TAC): This is a specialized resource that provides support and training in methods of test construction and validation. This support should provide further stimulus for active learning and objectives-based instruction. The objective is to target high standards of excellence, while fostering rules of fairness and equity. Study and evaluation of faculty performance indicators are another major concern for the Center.

Example of recent workshops and seminars organized by the DAD centers include:

- Experience sharing in developing online courses, May 26, 2004.
- Mentoring to enhance faculty development, Sept. 01, 2004.
- Developing the communication skills of students, Sept. 04-05, 2004.
- Active learning to foster critical thinking, Sept. 06, 2004.
- Using groups and students teams to promote learning, Sept. 07, 2004.
- Criteria for assigning letter grades, May 15, 2005.
- Evaluating the quality of teaching: An institutional framework, Sept. 03, 2005.
- Using Course Design to Create more Significant Learning Experiences for Students, Good Learning and Good Teaching: How do we Promote more of it?, Sept. 4, 2006.
- Three-Day Workshop on "Program Continuous Quality Improvement" by Dr. Mahesh Aggrawal from the Mechanical Eng. Dept. at the Gannon University USA, , KFUPM, September 14-15-16, 2008.
- Two-day workshop on "Peer Consultation in Teaching" Saturday 3-4, May 2008 from 4:00 pm to 8:00 pm. The workshop is offered by the TLC-DAD-KFUPM and Professor Sergio Piccinin.
- The Intel Workshop on "High Performance Computing Software Training". KFUPM, May 21-24, 2006.
- Workshop on "Engineering Design", by McMahon, Knecht, Baluch, Loughlin, Al-Qutub, and Youcef-Toumi. KFUPM, April 11-12, 2006.

The mission of the Deanship of Scientific Research (DSR) is to provide a stimulating environment and continuous support that empowers KFUPM faculty and researchers to enhance its national, regional and international leadership in quality research and scholarly activities in science, engineering, management and other related fields of significant importance to the Kingdom. The DSR strategy includes:

- Promote the culture of innovative, interdisciplinary, and collaborative research
- Motivate and support Junior faculty/graduate students research
- Maintain continuous financial support for research and scholarly activities
- Support the establishment and upgrading of state-of-the art research facilities
- Develop and maintain measurement criteria for research outcomes
- Promote the dissemination of research results in quality outlets (e.g. journals, conferences)
- Promote innovative research in cutting edge disciplines and technologies
- Encourage and support team work and interdisciplinary collaborative research.
- Encourage and support scholarly visits and conferences
- Support summer and other international research exchange programs
- Provide support for faculty to attend international technical conferences and meetings
- Establish strong links with scientific research agencies world-wide
- Reward active researchers
- Promote and support research groups

The DSR offers the following grants and awards to KFUPM faculty:

- SABIC and Fast Track Research Grants: For research projects having a maximum duration of 18 months and a maximum budget of SR75, 000.

- ***Internal Research Grants:*** These constitute the main research grant scheme at KFUPM, featuring flexible budget and project duration. They provide funding for faculty and facility development in existing and emerging areas of excellence.

- ***Junior Faculty Grants:*** This is a one time, 11 month, limited budget (SR 50,000) grant research opportunity for fresh PhD's starting their careers as junior faculty at KFUPM.
- ***Societal Grants:*** These grants are designed to enhance interaction of KFUPM with the society and enhance its direct contribution to meeting societal needs. They support research in areas other than science, technology and business which are related to the Saudi society.
- ***Book-Writing Grants:*** for authoring, translation and editing of books. Grants include authoring a scholarly monographs or textbooks targeted towards peers, students the general public in both English and Arabic and the translating relevant books or textbooks into Arabic.

- ***Conference Attendance:*** The University encourages faculty to participate in high-quality conferences and professional meetings organized by leading professional societies both in the Kingdom and abroad. Support normally covers per diem and conference registration fee and possibly round trip tickets to attend the conference. Each faculty can obtain KFUPM financial support to attend three conferences to present papers each year: one regional, one international, and one from a funded research project. In addition he can apply to attend a conference without presenting a paper based on a recently published journal paper.
- ***Sabbatical Leave:*** This scheme allows faculty to interact directly with scholars in reputable academic and research institutions. Scholarly activities may include pursuing or extending some ongoing research, initiating research in new and diverse areas, working in industry in research and development, gaining research-oriented experience, creating an engineering design or product or writing a research-oriented book or monograph. Benefits may include full monthly basic salary, regular transportation allowance, return air tickets for the faculty member and his eligible dependents, book allowance, research support, and a limited medical allowance.

CRITERION 7. FACILITIES

7.1. Space

The COE faculty and students have adequate facilities available for conducting a successful program. The facilities include several classrooms, course/research labs, Unix/Linux labs, College of Computer Sciences & Engineering (CCSE) general-purpose labs, faculty offices, university library, and network access facilities. The classrooms are mainly located in buildings 22, 23, and 24. Both labs and faculty offices are located in buildings 22 and 23. As for the university library it is located in building 8. The network access facilities are provided by the CCSE general-purpose labs in buildings 22 and 23, and by the Information Technology Center (ITC) in the form of a Wireless LAN network available in all university buildings. Supporting such facilities is a wealth of computer applications that are available to both faculty and students.

In the following sections we provide detailed information regarding the faculty offices, classrooms, the course/research labs, the Unix/Linux labs, the CCSE general-purpose labs, the university library, and the network access facilities.

1. Faculty Offices

Most of the faculty offices are located in building 22. Every faculty has his own office that has adequate furniture and is equipped with a desktop and/or notebook, a printer, and a network connection. In addition, most of the faculty offices are also equipped with a scanner. It should be noted, though, that some faculty offices are small in size such that they are inadequate to hold a discussion between the faculty and 2 students. The average faculty office space is about 107 square feet.

2. Classrooms

Presently, all classrooms are equipped with network connected computers and high-resolution projectors. They are primarily used to deliver electronic class notes and perform in-class demos and presentations. For these computers, commonly used Microsoft applications (such as Microsoft Office) are installed. Other more specific software/tools can be installed on request. It should be noted that none of the COE courses was prevented from being offered due to lack of available classrooms. Table 7.1-1 provides the minimum, the maximum, and the average classroom size in terms of the number of students the classroom can accommodate. Also, the table provides similar information regarding the auditoriums available for teaching and group meetings.

Table 7.1-1. Classrooms sizes.

Room Type	**Minimum (*chairs*)**	**Maximum (*chairs*)**	**Average (*chairs*)**
Lecture	18	120	38
Auditorium	50	180	102

3. Laboratories

Several labs are used by both faculty and students to fulfill course outcomes as well as to conduct research. Such labs are located in buildings 22 and 23. Table 7.1-2 summarizes the list of available labs and their sizes.

Table 7.1-2. Laboratories sizes.

	Lab Name	Location (building / Room)	Purpose	Courses served by lab	Lab capacity in number of students/session	Lab space (Sq. Ft.)
1.	Digital Logic Design Lab	22/340-A	Prototyping of logic circuits	COE 203	13	630
2.	Microprocessor Lab	22/340-B	Processor interfacing and building microcomputer systems	COE 305	12	630
3.	Network & Communication Lab	22/347-A	Conduct experiments related to all layers of TCP/IP protocol stack, network management, network architecture, and network security	COE 344, COE 444, COE 445, COE 485	20	820
4.	Digital System Design Lab	22/347-B	Design, implement, debug and document a major microcontroller based system	COE 400	27	630
5.	Printed Circuit Board Lab	23/019	Electronic circuit implementation on printed circuit boards	COE 400	8	930
6.	Robotics Lab	22/339	Conduct experiments on Internet Tele-Robotics using real-time Client-Server network programming	COE 484, COE 584	9	317
7.	Senior Design Project Lab	22/339-1	Teaching & Projects	COE 485, COE 446	10	317
8.	FPGA & Design Automation Lab	22/333-1	Research	COE 561	8	420
9.	Sensor Networks Lab	22/159	Research, senior design projects, and course projects	COE 485, COE 499	6	129
10.	Performance Engineering Lab	22/342	Research	–	3	201
11.	Graduate Research Lab	22/401	Research	–	6	291

All COE labs have the following equipment installed for safety purposes:

1- Fire extinguisher.
2- First aid kit.

3- Smoke detector.
4- Emergency power shutdown switch.
5- Lab safety & precaution guide document.

A brief description of each of the COE labs is outlined in the following subsections.

Digital Logic Design Lab

The Digital Logic Design Lab is primarily used for prototyping of logic circuits through the use of discrete components (74xx family), EEPROMs (AT 2764) and FPGAs (Xilinx Spartan-3). Hence, the students initially implement combinational circuits on prototyping boards using chips and wires. Next, sequential circuits are implemented using EEPROMs and Flip-Flops. Finally, the students are introduced to FPGA-boards which they program using Xilinx ISE 7.1i WebPack software.

Microprocessor Lab

The Microprocessor Lab is used by the students to perform Intel microprocessor interfacing and building microcomputer systems.

Network & Communication Lab

The Network & Communication lab is used for conducting experiments related to all layers of the TCP/IP protocol stack, network management, network architecture, network security, and wireless networking. Thus, the lab supports several courses concerned with such topics.

Digital System Design Lab

The Digital System Design Lab is used to integrate the students' knowledge in hardware and software gained from lecture and laboratory courses to design, implement, debug and document a major microcontroller based system.

Printed Circuit Board Lab

The Printed Circuit Board Lab is used to implement electronic circuits on printed circuit boards. The lab houses all equipment and chemicals necessary to make a professional printed circuit board starting from scratch. The main users of such lab are students of the digital system design course and the senior project course.

Robotics Lab

The Robotics Lab is used to conduct experiments on Internet Tele-Robotics using real-time Client-Server network programming. The objective is to provide a tool to carry out manual work through the Internet. The work is being done at a server station to which a robot arm is connected.

Senior Design Project Lab

The Senior Design Project Lab is used by the students to conduct their senior design project.

FPGA & Design Automation Lab

The FPGA & Design Automation Lab is used mainly to conduct research on digital systems and design automation.

Sensor Networks Lab

The Sensor Networks Lab is mainly used by faculty and graduate students to conduct research in the area of sensor networks. In addition, the lab is used by both senior design projects' students and students of the senior elective course on Wireless Sensor Networks to conduct experimentations and to implement projects in the subject matter.

Performance Engineering Lab

The Performance Engineering Lab is used to conduct research on parallelization of algorithms.

Graduate Research Lab

The Graduate Research Lab is mainly used by graduate students as a general purpose lab.

Unix/Linux Labs

The Unix/Linux Labs is not administrated by the COE department. The COE faculty and students have access to this lab to fulfill some course outcomes as well as to conduct research. The lab is located at room 22/413, whereas the Unix/Linux computer servers are located in room 22/338.

CCSE General-purpose Labs

Several CCSE general-purpose labs are available 24 hours, seven days a week to the students. These labs provide network access as well as a wealth of major computer applications needed by the students in support of their courses, projects, and research.

7.2. Resources and Support

Computing Resources

As stated in Criterion 7.1, every faculty's office is equipped with a desktop and/or notebook, a printer, and a network connection. In addition, most of the faculty offices are also equipped with a scanner. Similarly, all classrooms are equipped with high-

resolution projectors and network connected computers with commonly used Microsoft applications (such as Microsoft Office) being installed on them. Other more specific software/tools can be installed on request. In addition, students can access the network through the use of the CCSE general-purpose labs described earlier. Alternatively, both faculty and students can access the network through the use of the Information Technology Center (ITC) campus-wide IEEE 802.11 wireless LAN. The ITC wireless LAN helps reduce the demand on the general-purpose labs. In general, the ITC is the primary computing facility at KFUPM. It provides computing support for education, research, and administrative applications for the university community. Networking facilities at KFUPM have seen exponential growth over the last few years. The networking facilities provided by ITC comprise a fiber optic Gigabit Ethernet backbone serving more than 10,000 fast-Ethernet switched network points. All faculty offices, classrooms and PC labs are connected to the network. Faculty housing and multi-story student dorms buildings are also connected to the network. As stated earlier, the network is enhanced to provide IEEE 802.11 wireless LAN connectivity to all academic buildings across the campus. A total of 390 access points have been installed across the campus. Dial-up facilities are also available for remote access to KFUPM Intranet and Internet resources. Figure 7.2-1 shows the overall network connectivity at KFUPM.

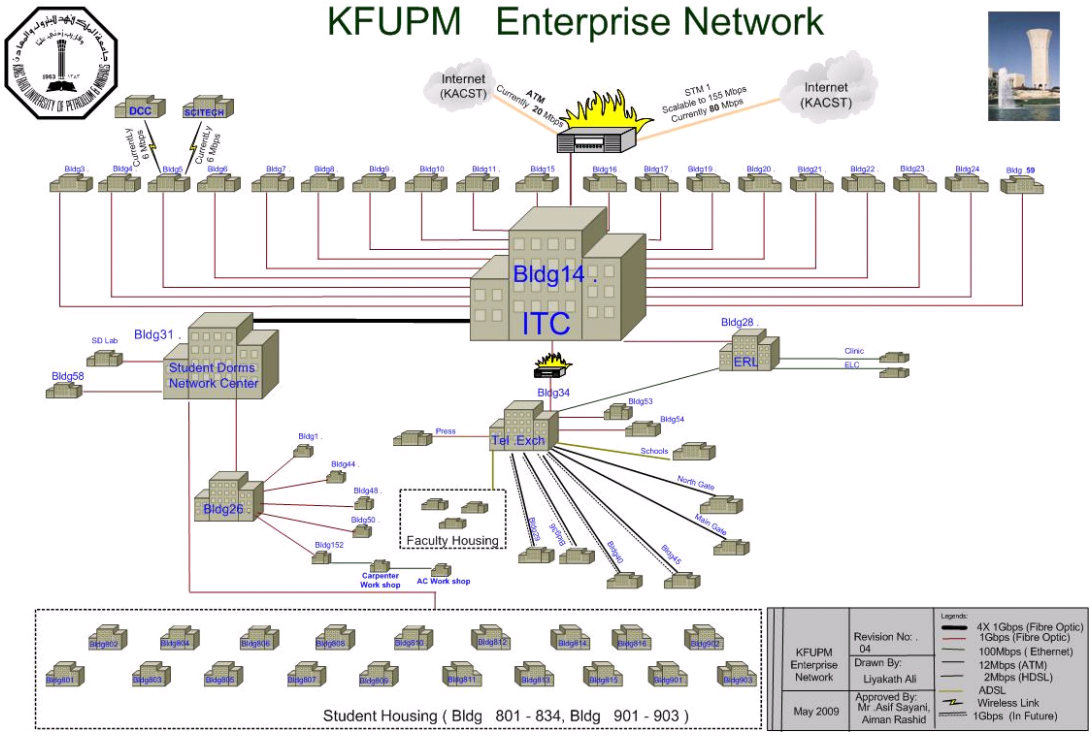


Figure 7.2-1. KFUPM network connectivity.

In addition to the aforementioned computing resources, several labs are used by both faculty and students to fulfill course outcomes as well as to conduct research. Each lab is equipped with adequate set of hardware and software items as stated in Criterion 7.1 and as presented in Appendix C. All previously stated computing

resources are adequate for the student's ability to achieve the program's outcomes and the faculty's teaching and scholarly activities.

Laboratory Equipment Planning, Acquisition, and Maintenance

The COE department continuously addresses any upgrades/additions for the labs by estimating the yearly budget needed for the labs and submitting it to the university. The full process used to determine the department lab budget is divided into two levels: (1) the university level, and (2) the department level. The two levels are described next.

At the university level, as every fiscal year is coming to an end, the planning committee at the university level is required to review the needs of major equipment and PCs of all academic colleges and make consolidated recommendations for the allocation of an appropriate budget for the next fiscal year. In this connection, a memo will be sent to all the academic colleges/departments by the chairman of the university planning committee at least four months before the end of every fiscal year requesting them to prepare their lists of major equipment and PCs for labs to be procured during the following fiscal year. A standard proforma is provided to all the departments to fill their lists of major equipment and PCs for labs. This process is currently being conducted online.

At the department level, the chairman of the COE department labs committee will send a memo to all the faculty and lab coordinators asking them to prepare the list of major equipment, software tools and PCs for all the labs to be procured during the following fiscal year. The lists of items required for all the labs are to be prepared on the prescribed proforma providing appropriate information in all the following columns – *Item description, quantity, estimated unit cost, Total amount, Priority, justification.* These form the basis for future lab budget allocations and justifications. All lab coordinators will be required to discuss the requirements of their respective labs with the course coordinators and all the instructors teaching the respective courses. The objective is to consider the upgrade/enhancement of lab facilities (in terms of addition of new equipment and PCs as well as replacing old PCs) to:

- Support lab experiments, students senior design projects, course projects, and MS thesis work.
- Support the conduct of newly proposed lab experiments.
- Support setting up of new labs proposed in the emerging areas.
- To support faculty research.
- To remove obsolescence (i.e., Modernization of the labs).

Once these requirements are received from the lab coordinators and faculty on the prescribed proforma, a consolidated list is prepared indicating the budget allocation required for each of the labs as well as a summary of the total labs budget projection. The department labs requirements will be presented at the college council by the COE department chairman and will then be taken up for discussion and subsequent approval. Budget approved at the college council will be sent to the university planning committee for necessary action. Also the labs budget requirements will be entered at the university lab budget online system.

With that process in mind, Table 7.2-1 provides the approved labs budgets for the fiscal years 2005 to 2009.

Table 7.2-1. Approved labs budgets (Fiscal years 2005 – 2009).

YEAR	EQUIPMENT COST (SR)	PCs COST (SR)	TOTAL COST (SR)
2005	521,326	343,000	864,326
2006	488,775	134,280	623,055
2007	356,795	183,000	539,795
2008	820,250	110,000	930,250
2009	788,000	48,000	836,000
TOTAL	**2,975,146**	**818,280**	***3,793,426***

Note that the fluctuations in the lab budgets is due to many factors including, but not limited to, the need to expand the current educational and research facilities in a particular year, faculty needs for various projects, and the availability of consumable components. The COE department lab-wise budget allocation summary for the fiscal years 2005-2009 is provided in Table 7.2-2 through Table 7.2-6.

Table 7.2-2. Lab budget allocation (Fiscal year 2005).

YEAR 2005			
LAB	**EQUIPMENT COST (SR)**	**PCs COST (SR)**	**TOTAL COST (SR)**
ROBOTICS LAB	40,000	20,000	60,000
FPGA & DESIGN AUTOMATION LAB	100,000	25,000	125,000
MICROPROCESSOR LAB	32,000	100,000	132,000
DIGITAL LOGIC DESIGN LAB	47,000	25,000	72,000
SENIOR DESIGN PROJECTS LAB	52,000	25,000	77,000
PERFORMANCE ENGINEERING LAB	50,000	25,000	75,000
PRINTED CIRCUIT BOARD LAB	45,000	--	45,000
SYSTEMS DESIGN LAB	42,850	55,000	97,850
NETWORK AND COMMUNICATION LAB	102,476	58,000	160,476
COE GRADUATE LAB	10,000	10,000	20,000
TOTAL	**521,326**	**343,000**	***864,326***

Table 7.2-3. Lab budget allocation (Fiscal year 2006).

YEAR 2006			
LAB	**EQUIPMENT COST (SR)**	**PCs COST (SR)**	**TOTAL COST (SR)**
ROBOTICS LAB	82,000	--	82,000
FPGA & DESIGN AUTOMATION LAB	47,830	--	47,830
MICROPROCESSOR LAB	10,000	--	10,000
DIGITAL LOGIC DESIGN LAB	50,000	--	50,000
SENIOR DESIGN PROJECTS LAB	20,000	--	20,000
PERFORMANCE ENGINEERING LAB	54,700	--	54,700
PRINTED CIRCUIT BOARD LAB	47,250	--	47,250
SYSTEMS DESIGN LAB	51,020	--	51,020
NETWORK AND COMMUNICATION LAB	115,975	134,280	250,255
COE GRADUATE LAB	10,000	--	10,000
TOTAL	**488,775**	**134,280**	***623,055***

Table 7.2-4. Lab budget allocation (Fiscal year 2007).

YEAR 2007			
LAB	**EQUIPMENT COST (SR)**	**PCs COST (SR)**	**TOTAL COST (SR)**
ROBOTICS LAB	10,000	--	10,000
FPGA & DESIGN AUTOMATION LAB	30,000	--	30,000
MICROPROCESSOR LAB	57,200	--	57,200
DIGITAL LOGIC DESIGN LAB	40,000	--	40,000
SENIOR DESIGN PROJECTS LAB	22,000	--	22,000
PERFORMANCE ENGINEERING LAB	20,000	--	20,000
PRINTED CIRCUIT BOARD LAB	10,000	--	10,000
SYSTEMS DESIGN LAB	48,000	63,000	111,000
NETWORK AND COMMUNICATION LAB	48,125	--	48,125
COE GRADUATE LAB	10,000	--	10,000
SENSOR NETWORKS LAB	61,470	120,000	181,470
TOTAL	**356,795**	**183,000**	***539,795***

Table 7.2-5. Lab budget allocation (Fiscal year 2008).

YEAR 2008			
LAB	**EQUIPMENT COST (SR)**	**PCs COST (SR)**	**TOTAL COST (SR)**
ROBOTICS LAB	92,000	--	92,000
FPGA & DESIGN AUTOMATION LAB	--	48,000	48,000
MICROPROCESSOR LAB	85,000	--	85,000
DIGITAL LOGIC DESIGN LAB	50,100	--	50,100
SENIOR DESIGN PROJECTS LAB	82,000	--	82,000
PRINTED CIRCUIT BOARD LAB	120,000	--	120,000
SYSTEMS DESIGN LAB	101,850	--	101,850
NETWORK AND COMMUNICATION LAB	113,300	18,000	131,300
COE GRADUATE LAB	--	36,000	36,000
SENSOR NETWORKS LAB	106,000	8,000	114,000
ALL COE LABS	70,000	--	70,000
TOTAL	**820,250**	**110,000**	***930,250***

Table 7.2-6. Lab budget allocation (Fiscal year 2009).

YEAR 2009			
LAB	**EQUIPMENT COST (SR)**	**PCs COST (SR)**	**TOTAL COST (SR)**
ROBOTICS LAB	80,000	--	80,000
FPGA & DESIGN AUTOMATION LAB	135,000	--	135,000
MICROPROCESSOR LAB	30,000	--	30,000
DIGITAL LOGIC DESIGN LAB	46,000	--	46,000
SENIOR DESIGN PROJECTS LAB	90,000	--	90,000
PRINTED CIRCUIT BOARD LAB	100,000	--	100,000
SYSTEMS DESIGN LAB	97,000	--	97,000
NETWORK AND COMMUNICATION LAB	105,000	--	105,000
COE GRADUATE LAB	--	36,000	36,000
SENSOR NETWORKS LAB	85,000	--	85,000
ALL COE LABS	20,000	12,000	32,000
TOTAL	**788,000**	**48,000**	***836,000***

Once the budgets have been approved by the university, the acquisition of the laboratory equipment is done through the submission of purchasing requests to the university purchasing department. In turn, the purchasing department requests quotes from several vendors. Once the quotes are received and compared against the purchasing requests, a vendor is selected and a purchase order is submitted to acquire the requested lab equipment.

With respect to labs maintenance, the lab support personnel, and in coordination with lab instructors, is responsible for determining if a defective equipment is to be repaired in-house, repaired at the manufacturer, or replaced.

The laboratory equipment planning, acquisition, and maintenance processes are adequate for achieving the program's outcomes at COE.

Departmental Hardware, Software, and Networks Support Personnel

The College of Computer Sciences and Engineering (CCSE) has its own complete IT infrastructure, which provides all the standard IT facilities to our faculty, staff and students. Currently, there are 17 network engineers and technicians providing IT support to the college. Among them, there are 5 MSc graduate holders. The CCSE network support is divided into the following: windows system administration and user support (3 personnel), UNIX system administration and support (2 personnel), network hardware and infrastructure (5 personnel), PC lab and classroom administration (6 personnel) and administrative, inventory and purchasing (1 personnel).

Departmental Laboratory Equipment Support Personnel

The COE department has one dedicated engineer with a BSc in Electronics and Electrical Engineering for all departmental laboratory equipment support. Note that the CCSE general-purpose labs are maintained by the college's support personnel as explained in the previous subsection.

7.3. Major Instructional and Laboratory Equipment

A list of major instructional and laboratory equipment is provided in Appendix C.

CRITERION 8. SUPPORT

8.1. Program Budget Process

The COE departmental budget is part of the overall college budget. The COE departmental budget is mainly dominated by the laboratory budget that is submitted separately per the process explained in Criterion 7.2. Additional COE budget items include wages, travel, supplies, …, etc. In addition to the approved laboratory budgets presented earlier, Table 8.1-1 provides the departmental expenditures for the fiscal year 2008 for items other than lab equipment.

Table 8.1-1. Department expenditure (Fiscal year 2008).

Item	SR
Wages	5,222,543.29
Faculty & Staff Allowances	528,565.43
Travel	426,833.33
Supplies	308,832.60
Training	33,472.69
Advertisement	3,044.00
Total Expenditure	***6,523,291.34***

8.2. Sources of Financial Support

KFUPM is a fully supported government institution, with the entire budget coming from the Saudi government. Moreover, KFUPM also receives financial contributions from industrial institutions (mainly Saudi ARAMCO). However, such contributions amount to only a small fraction (less than 1%) of the government allocations. Thus, the main source of departmental financial support is from government allocations. Additional sources of departmental financial support come indirectly from faculty funded research grants and industry consultations.

8.3. Adequacy of Budget

As evident from Criterion 7.2 and Criterion 8.1, the COE department has adequate budget to continue updating and enhancing the labs, to achieve its program's outcomes, and to support the faculty's teaching and scholarly activities.

8.4. Support of Faculty Professional Development

As stated in Criterion 6.7 (Faculty Development), the faculty professional development efforts represent a prime objective of KFUPM administration and are manifested in the following two areas:

1. Academic Development, which is administered by the Deanship of Academic Development.
2. Research Development, which is administered by the Deanship of Scientific Research.

Funding allocated by the university is adequate for the needs of both deanships. Accordingly, both planned activities and allocated funding are adequate for the

faculty professional development. Refer to Criterion 6.7 for further explanation on the KFUPM supported activities in this area, and how they are planned.

8.5. Support of Facilities and Equipment

The allocation of office space and laboratory facilities is the responsibility of the university office and housing department. On the other hand, the scheduling of classrooms is the responsibility of the university registrar. Moreover, the university maintenance department is responsible for all maintenance issues related to offices, laboratories, and classrooms other than computer or projector related issues. The university maintenance department accepts maintenance requests online as well as through an automated telephone system. As stated earlier, the computer or projector maintenance issues are the responsibility of the CCSE personnel, ITC personnel, and/or the university audio/visual department. Thus, the support of facilities and equipment is adequate to achieve program's outcomes.

8.6. Adequacy of Support Personnel and Institutional Services

The COE department has two qualified secretaries to assess the department in all administrative aspects. Similarly, and as explained in Criterion 7.2, the COE department relies on the college Network/Computing services group for support on computing and networking facilities. Likewise, the COE department has a dedicated engineer to supervise the tasks of running, maintaining, and upgrading the various teaching and research laboratories at the department. Accordingly, the aforementioned personnel resources are adequate to meet the COE program's outcomes.

Furthermore, the COE department and faculty rely heavily on the excellent resources and support facilities provided by the university. These include:

1. The Information Technology Center (ITC).
2. The Purchasing Department
3. The Maintenance Department
4. The Office and Housing Department
5. The Central Library.

The role of both the ITC and the purchasing department in supporting the COE department have been explained in Criterion 7.2. On the other hand, the role of both the maintenance department and the office and housing department in supporting the COE department have been described in Criterion 8.5.

With respect to the central library it is considered as a science and engineering library. Nearly 80% of its collection is related to the fields of science and engineering. The collection includes books, periodicals, proceedings, theses, reports, maps, charts, electronic resources, and audiovisual materials. The library has acquired a good number of electronic databases and Internet resources, and has established searching mechanisms for such databases. Faculty and students have Intranet and Internet remote access to almost all the databases using the library's URL http://ww.kfupm.edu.sa/library/. The library provides assistance to the faculty and students in their search for information and library materials. Table 8.6-1 provides a summary of the library's collection:

Table 8.6-1. KFUPM main library's collection.

Item	Quantity
Monographs (including proceedings) vols.	248,919
Periodicals (Bound)	82,411 volumes
Electronic Books	66,000 documents
Periodicals titles (subs)	668
Electronic Journals (Full texts and Bibliog.)	47,000
Electronic Documents (proceedings, reports, etc.)	1,889
Electronic Databases (Journals, books)	49
Microfilms	1,532 reels
Microfiche	1,517 reels
Media (audio, video, slides, maps, charts etc.)	4,986 pieces

More specifically, Table 8.6-2 provides a summary of the number of available books and bound periodicals in areas related to COE:

Table 8.6-2. Number of library items related to COE.

Item	Quantity
Computer Engineering	2,450
Information & Computer Science	11,479
Systems Engineering	5,175
Electrical Engineering	25,388

In addition, the library has 7,432 journals in databases and current subscriptions in the area of Computer Science and Engineering including 1,131 journals in databases and current subscriptions in the area of Electrical Engineering.

The library continuously expands its collection as shown in Table 8.6-3 that summarizes the amount of library expenditures for the years 2006-2008.

Table 8.6-3. KFUPM main library's expenditures (Fiscal years 2006 – 2008).

Deanship of Library Affairs Expenditures Record for the years 2006-2008			
Description	**2006**	**2007**	**2008**
Total Library Current Funds	**6,415,605**	**7,098,916**	**8,478,580**
Expenditure for the ***Science and Engineering*** Unit (80% of total)	**5,132,484**	**5,679,133**	**6,782,864**
Books	716,985	476,026	890,503
Electronic Databases	1,528,612	2,606,999	3,433,053
Periodicals	2,752,232	2,506,990	2,427,943
Other expenditures (Interlibrary Loan, Shipping, Non-print materials)	134,651	89,116	31,367

The library has 32 professional and 29 para professional staff members with recognized library service training. The operating hours of the library are Saturday to Tuesday from 7:30 a.m. to 10:00 p.m., Wednesday from 7:30 a.m. to 8:00 p.m., Thursday from 9:00 a.m. to 3:30 p.m. (for men) and 4:00 p.m. to 9:00 p.m. (Ladies), and Friday from 2:00 p.m. to 8:00 p.m. The library hours during exam periods are extended.

Another university service that was introduced recently is the KFUPM Portal System. The system has been launched as a university-wide enterprise automation system that facilitates access to global university information and services (IT issues, library, Research, Deanships, administration, etc.). The portal speeds up many faculty services including applications for conference attendance, submission and reviewing of research proposals, promotion applications, office and housing services, maintenance requests, and the processing of purchase orders.

Lastly, KFUPM offers an attractive compensation package for faculty, including tax-free salary, free furnished housing including all utilities, free annual air tickets, free medical care at KFUPM clinics and government hospitals, etc.

All previously stated institutional benefits provide sufficient and adequate services to the COE department to achieve its program’s outcomes.

CRITERION 9. PROGRAM CRITERIA

The ABET computer engineering program criteria focuses only on one section of the general criteria, the curriculum. The Criteria for Accrediting Engineering Programs specifies the following:

These program criteria apply to engineering programs which include electrical, electronic, computer, or similar modifiers in their titles.

1. *The structure of the curriculum must provide both breath and depth across the range of engineering topics implied by the title of the program.*

   The COE program provides breadth across the computer hardware-software spectrum. In addition, it provides considerable depth in the following fields: VLSI Design, Computer Architecture, Robotics, and Computer Networks. The combination of circuit design, logic design, computer architecture, computer interfacing, and computer communication coupled with the strong series of design laboratories provides students with a comprehensive treatment of modern hardware design (COE 202, 203, 205, 305, 308, 341, 350-352, 360, 400, and 485). Networking protocols and applications, coupled with some software design provides students with an integrated view of the software development process and computer networks (ICS 102, 201, 202, 253, 324 (for the COOP option), 431, COE 344).

2. *The program must demonstrate that graduates have: knowledge of probability and statistics, including applications appropriate to the program name and objectives; and knowledge of mathematics through differential and integral calculus, basic sciences, computer science, and engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components, as appropriate to program objectives.*

   The COE program ensures that students have a working knowledge of the above areas through requirements for the following courses:

   1. *Probability and statistics*

      The program requires a common engineering course in probability and statistics with engineering applications. (STAT 319)

   2. *Knowledge of mathematics through differential and integral calculus*

      The program requires knowledge of mathematics, including two preparatory courses, three courses in calculus, and one course in

differential equations and linear algebra. (MATH 001, 002, 101, 102, 201, 260) in addition to a course on Discrete Math (ICS 252).

3. *Basic sciences*

   The program requires two courses in physics, and one course in chemistry. (PHYS 101, 102, CHEM 101)

4. *Computer science*

   The program requires many courses in computer science including introduction to computing, data structures, and operation systems (ICS 102, 201, 202, 431)

5. *Engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components, as appropriate to program objectives.*

   The program requires many courses that provide the student with a comprehensive experience in how to analyze and design logic circuits, logic devices and subsystems, and software subsystems. (COE 202, 203, 205, 305, 308, 341, 344, 360, 400, 485, 351)

- *Programs containing the modifier "computer" in the title must also demonstrate that graduates have knowledge of discrete mathematics.*

  The program requires one course in discrete math. (ICS 253)

Cooperative Education Criteria

One of the significant strengths of the COE curriculum is the Cooperative (COOP) program. The COE COOP program aims at enhancing the professional development through an alternate sequence of industry and academic experiences. Students have the option to participate in the COOP program or not.

The COOP program is a continuous period of 28 weeks taken in two consecutive semesters; COE 351 + COE 352 (Spring + Summer) or COE 350 + COE 351 (Summer + Fall). COOP training is spent in industry with the purpose of acquiring

practical experience in different areas of Computer Engineering. During this period, a student is exposed to the profession of Computer Engineering by working in the field.

Students are required to submit progress reports during their COOP. After finishing the COOP period, they are required to submit a final report and give a presentation about their experience and the knowledge they gained during their work. COOP students performance is evaluated through the company evaluation, four progress reports, a final report, a summary report, and a presentation on the COOP training to an examining committee.

The COOP is a 9 credit hour course. Thus, a student who selects the COOP option does not need to complete the COE 485 (Senior Design Project). In addition, he needs to take the database systems course (ICS 324), 1 general elective instead of 3, and 2 COE electives instead of 3. The total required credit hours for the COE BS degree with the COOP option includes an extra credit hour compared to the same degree without the COOP option.

A COE student is eligible for the COOP program if he has completed 85 credit-hours or more of his study, earned a cumulative and a major GPA of 2.0 or above, and has passed a set of required courses. The COOP work must be completed before the student's last semester in the University. All COOP prerequisite courses have to be completed at least two semesters prior to the student's graduation. Thus, it is recommended to start the COOP the summer following the fourth (junior) year. The student will need to spend the summer and the first semester of the fifth (senior) year in the COOP. He will then have one more semester to finish his courses and complete the COOP requirements.

Students planning to take COOP discuss the training with their academic advisors, and contact the COOP office to get a list of COOP offers. They also need to indicate three choices of companies. The COOP office coordinates the assignment of students to companies. Students have also the option to do the COOP in a company that is not in the COOP program list, but this needs to be arranged with the company and the COOP program office.

COOP students are reminded that they are ambassadors of the KFUPM COE department. So, their performance in the COOP period affects both the image of the COE department and the future prospects of jobs of COE graduates. They are encouraged to promote the professionalism, ethics and high quality education they received at the department. They are also reminded to take the initiative to gain useful experience during the COOP program.

Through the COOP training, students develop a better sense of their capabilities, come to know about opportunities that exist for them in industry and government. The COE places the students in leading companies, such as ARAMCO, SBM, and STC. COE COOP students receive employment offers from their COOP sponsors following their training.

Students who do not select the COOP option will also have to take a summer training (COE 399) with a pass/fail credit. The aim of the summer training is to provide students with direct on-the-job experience working with professionals in the field. This training exposes students to the reality of professional practice. Students are

required to submit a report and make a presentation on their summer training experience and the knowledge gained.

Appendix A

COURSE SYLLABI

COURSE SYLLABUS

1. **Department, Number and Course Title**

   Department: Computer Engineering

   Course Number: COE 202

   Course Title: Digital Logic Design

2. **Design:** Required Course

3. **Catalog Description**

   Introduction to Computer Engineering. Digital Circuits. Boolean algebra and switching theory. Manipulation and minimization of Boolean functions. Combinational circuits analysis and design, multiplexers, decoders and adders. Sequential circuit analysis and design, basic flip-flops, clocking and edge-triggering, registers, counters, timing sequences, state assignment and reduction techniques. Register transfer level operations.

4. **Prerequisite(s)**

   PHYS 101 and MATH 101

5. **Textbook(s) and/or other Required Material**

   Morris Mano and Charles Kime, Logic and Computer Design Fundamentals, Fourth Edition, Prentice Hall International.

6. **Course Objectives**

   After successfully completing the course, students will be able to

   - Carry out arithmetic computations in various number systems (Binary, Octal, and Hexadecimal).
   - Apply rules of Boolean algebra to simplify Boolean expressions.
   - Translate Boolean expressions into equivalent truth tables and logic gates implementations and vice versa.
   - Design efficient combinational and sequential logic circuit implementations from functional description of digital systems.
   - Carry out simple CAD simulations to verify the operation of logic circuits

7. **Topics Covered**

   - ***Number System and Codes:*** Information Processing, and representation. Digital vs Analog quantities. General Number Systems. Binary, Octal and Hexadecimal systems. Number System Arithmetic (Addition, Subtraction & Multiplication). Number base conversion. Binary Storage & Registers. Signed Binary Number representation (Signed Mag, R's &(R-1)'s Complement). Signed Binary Addition and Subtraction ((R-1)'s, R's Complement Addition and Subtraction). Codes. BCD, Excess-3, Parity Bits, ASCII & Unicode.

   - ***Binary Logic & Gates:*** Boolean Algebra; basic identities, algebraic manipulation, complement of a function. Canonical and Standard forms, minterms and Maxterms, Sum of products and Products of Sums. Physical properties of gates: fan-in, fan-out, propagation delay, timing diagrams and Tri-state drivers. *Map method of simplification*: Two-, Three-, Four-and Five-variable K-Maps. Essential prime implicants, simplification procedure, SOP & POS simplification, Don't care conditions. Universal gates; *NAND, NOR gates:* 2-level

implementations. *Multilevel Circuits.* Exclusive-OR (XOR) and Equivalence (XNOR) gates, Odd and Even Functions, Parity generation and checking.

- ***Combinational Logic:*** Design Procedure & Examples. Half and Full Adders, Binary Adders: *4-Bit* Ripple Carry Adder and *delay* analysis. Carry Look-Ahead Adder, Adder-Subtractor circuit. MSI parts. Decoders, Decoder expansion, combinational logic implementation using decoders, Encoders & Priority Encoders, Multiplexers, Function Implementation using multiplexers, Demultiplexers, Magnitude Comparator. Design Examples.
- ***Sequential Circuits:*** Latches, Clocked latches: SR, D, T and JK. Race problem in clocked JK-Latch. *Function & Excitation Tables of clocked latches:* SR, D, T and JK. *Flip-Flops:* Master-Slave, and edge-triggered. Function & Excitation Tables of T-FF. *Asynchronous/Direct Clear and Set Inputs.* Setup &Hold times. *Sequential Circuit Design*: Excitation Tables. Design procedure, State diagrams and state tables. *Sequential Circuit Analysis:* Input equations, State table. Mealy vs. Moore models of FSMs. Examples. Registers and counters.
- ***Memory & PLDs:*** Memory devices: RAMs & ROMs . Combinational Circuit Implementation with ROM. Programmable Logic Devices: PLAs, PALs, and FPGA'a

8. **Course Contribution to Meet the Professional Component**

   This course emphasizes the design and analysis of combinational as well as sequential digital logic circuits. For this end, the course also emphasizes the ability of students to use Boolean algebra to simplify functions using both the algebraic and the K-map techniques.

9. **Relationship to Program Outcomes**

   This course supports the following three program outcomes out of the outcomes required by ABET Criterion 3 for accrediting computer engineering programs.

   Outcome 1: Ability to apply math and Boolean algebra in performing computations in various number systems and simplification of Boolean algebraic expressions. **[ABET Criterion 3a]**

   Outcome 2: Ability to design efficient combinational and sequential logic circuit implementations from functional description of digital systems. **[ABET Criterion 3c]**

   Outcome 3: Ability to use CAD tools to simulate and verify logic circuits. [**ABET Criterion 3k**]

10. **Prepared by**: Dr. Alaaeldin Amin, November 19, 2006.

COURSE SYLLABUS

1. **Department, Number and Course Title**

   Department: Computer Engineering

   Course Number: COE 203

   Course Title: Digital Logic Laboratory

2. **Design:** Required Course

3. **Catalog Description**

   Review of Digital Logic Design: Design of Combinational Circuits, and Design of Sequential Circuits. Logic implementation using discrete logic components (TTL, CMOS), and programmable logic devices. Introduction to Field Programmable Logic Arrays (FPGAs). The basic design flow: design capture (schematic capture, HDL design entry, design verification and test, implementation (including some of its practical aspects), and debugging. Design of data path and control unit.

4. **Prerequisite(s)**

   Digital Logic Design (COE 202)

5. **Textbook(s) and/or other Required Material**

   Morris Mano and Charles Kime, Logic and Computer Design Fundamentals, Third Edition, Prentice Hall International, 2004.

6. **Course Objectives**

   After successfully completing the course, students will be able to

   - Design combinational and sequential circuits using discrete components, EEPROMs, and FPGAs to meet certain specifications.
   - Use basic structural Hardware Description Languages to implement digital circuits.
   - Design and conduct experiments related to digital systems and analyze their outcomes.

7. **Topics Covered**

   - ***Combinational Logic Design Review*:** K-maps, universal gates, and MSI components.
   - ***Sequential Logic Design Review*:** Flip-flops, counters and registers, sequential circuits analysis and design.
   - ***Prototyping of logic circuits*:** Introduction to ICs and discrete components, logic 74xx and 54xx families, power and ground, implementation of a simple combinational circuit.
   - ***EEPROM*:** Introduction to logic prototyping using PLDs, implementation of a sequential circuit using EEPROMs and external registers.

- ***FPGAs and HDL*:** Introduction to FPGAs design flow, design and implementation of a sequential circuit using schematic design entry, introduction to hardware description languages (HDL), structural modeling using verilog, complete design and implementation of a small combinational circuit, Register Transfer Level (RTL) modeling using verilog, complete design and implementation of a simple datapath, sequential circuit implementation using verilog.
- ***Design and implementation of a data path and control unit*:** A small processor implementation, integrating HDL and schematic units, data path and control unit design project.

8. **Class/Laboratory Schedule**

   3 hours per week.

9. **Course Contribution to Meet the Professional Component**

   This course emphasizes the use of FPGAs and HDL to implement combinational and sequential circuits. The students use various software tools to model, simulate and implement digital circuits. They also design test benches to analyze certain parameters of the circuit. Every week they are required to submit a lab report of the previous experiment. The course project is intended to build the students' ability to design, implement, simulate, and verify the operation of a simple datapath and control unit. In the project, the students work in teams. At the end they deliver a presentation and submit a project report.

10. **Relationship to Program Outcomes**

   Outcome 1: The ability to design combinational and sequential circuits to meet certain specifications **[ABET Criterion 3c]**
   Outcome 2: The ability to use tools and discrete components, EEPROMs, FPGAs, to model, simulate and implement digital circuits. **[ABET Criterion 3k]**
   Outcome 3: The ability to design and conduct experiments related to digital systems and to analyze their outcomes. [**ABET Criterion 3b**]
   Outcome 4: The ability to work in teams. [**ABET Criterion 3d**]
   Outcome 5: The ability to communicate effectively. [**ABET Criterion 3g**]

11. **Prepared by**: Syed Z. Shazli, November 14, 2006.

COURSE SYLLABUS

1. **Department, Number and Course Title**

   Department: Computer Engineering

   Course Number: COE 205

   Course Title: Computer Organization & Assembly Language

2. **Design:** Required Course

3. **Catalog Description**

   Introduction to computer organization. Signed and unsigned number representation, character representation, ASCII codes. Assembly language programming, instruction format and types, memory and I/O instructions, dataflow, arithmetic, and flow control instructions, addressing modes, stack operations, and interrupts. Datapath and control unit design. RTL, microprogramming, and hardwired control. Practice of assembly language programming.

4. **Prerequisite(s)**

   Digital Logic Design (COE 202) and Introduction to Computing I (ICS 102).

5. **Textbook(s) and/or other Required Material**

   Kip Irvine: Assembly Language for Intel-Based Computers**,** 5th edition.

6. **Course Objectives**

   After successfully completing the course, students will be able to

   - Describe the basic components of a computer system, its instruction set architecture and its basic fetch-execute cycle operation.
   - Describe how data is represented in a computer and recognize when overflow occurs.
   - Recognize the basics of assembly language programming including addressing modes.
   - Analyze, design, implement, and test assembly language programs.
   - Recognize, analyze, and design the basic components of a simple CPU including datapath and control unit design alternatives.
   - Recognize various instruction formats.

7. **Topics Covered**

   - ***Introduction and Information Representation:*** Introduction to computer organization. Instruction Set Architecture. Computer Components. Fetch-Execute cycle. Signed number representation ranges. Overflow.
   - ***Assembly Language Concepts:*** Assembly language format. Directives vs. instructions. Constants and variables. I/O. INT 21H. Addressing modes.
   - ***Intel x86 Assembly Language Programming:*** Register set. Memory segmentation. MOV instructions. Arithmetic instructions and flags (ADD, ADC, SUB, SBB, INC, DEC, MUL, IMUL, DIV, IDIV). Compare, Jump and loop (CMP, JMP, Cond. jumps, LOOP). Logic, shift and rotate. Stack operations. Subprograms. Macros. I/O (IN, OUT). String instructions. Interrupts and interrupt processing, INT and IRET.

- ***CPU Design:*** Register transfer. Data-path design. 1-bus, 2-bus and 3-bus CPU organization. Fetch and execute phases of instruction processing. Performance consideration. Control steps. CPU-Memory interface circuit. Hardwired control unit design. Microprogramming. Horizontal and Vertical microprogramming. Microprogrammed control unit design.
- ***Instruction Set Formats:*** Fixed vs. variable instruction format. Examples of instruction formats.

8. **Class/Laboratory Schedule**

   3 lecture hours. Each lecture hour is 50 minutes. The lab is 3 hours per week.

9. **Course Contribution to Meet the Professional Component**

   This course emphasizes the use of assembly language tools such as the Microsoft Macro Assembler, Linker, and Debugger to develop, analyze, and debug Intel x86 assembly language programs. The lab work emphasizes the use of tools and provides hands on experience in assembly language programming. The course project is intended to make the students apply the concepts learned in the course in designing and implementing a program satisfying a given functionality through team work. The project also involves requirements of self-learning capability.

10. **Relationship to Program Outcomes**

    This course supports the following five program outcomes out of the outcomes required by ABET Criterion 3 for accrediting computer engineering programs.

    Outcome 1: Ability to analyze, design, implement, and test assembly language programs. **[ABET Criterion 3c]**

    Outcome 2: Ability to use tools and skills in analyzing and debugging assembly language programs. **[ABET Criterion 3k]**

    Outcome 3: Ability to design the datapath and control unit of a simple CPU. [**ABET Criterion 3c**]

    Outcome 4: Ability to demonstrate self-learning capability. [**ABET Criterion 3i**]

    Outcome 5: Ability to work in a team. [**ABET Criterion 3d**]

11. **Prepared by**: Dr. Aiman H. El-Maleh, November 12, 2006.

COURSE SYLLABUS

1. **Department, Number and Course Title**

   Department: Computer Engineering

   Course Number: COE 305

   Course Title: Microcomputer System Design

2. **Design:** Required Course

3. **Catalog Description**

   Microprocessor architecture and organization, Bus architectures, types and buffering techniques, Memory and I/O subsystems, organization, timing and interfacing, Peripheral controllers and programming. Practice of the design of a microprocessor system design, testing, debugging and reporting.

4. **Prerequisite(s)**

   Digital Logic Lab (COE 203) and Computer Organization and Assembly Language (COE 205)

5. **Textbook(s) and/or other Required Material**

   Barry B. Brey, The Intel Microprocessors, Processor Architecture, Programming, and Interfacing, Seventh Edition, 2006, Prentice Hall

6. **Course Objectives**

After successfully completing the course, students will be able to

- Describe the functions of various pins on the processor and processor Memory/IO Read and Write bus cycle operations.
- Identify the main types of memory technology, describe memory internal organization and design an interface to memory.
- Specify and design simple computer serial and parallel interfaces.
- Describe how interrupts are used to implement I/O control and data transfers, design small interrupt service routines and I/O drivers using assembly language.
- Describe data access from magnetic and optical disk drives using DMA.
- Recognize various types of bus interfaces in a computer system.
- Design and fabricate a medium-sized 8086 based microcomputer system.

7. **Topics Covered**

- 80x86 Processor Architecture :Processor Model, Programmer's model, Designer's Model : 8086 hardware details, Clock generator 8284A, Bus buffering and latching, Processor Read & Write bus cycles, Ready and wait state generation, Coprocessor NDP 8087 interface, 8288 bus controller, Pentium processor architecture.
- Memory Interfacing :80x86 processor-Memory interfacing, Address decoding techniques, Memory Devices – ROM, EPROM, SRAM, FLASH, DRAM devices, Memory internal organization, Memory read and write timing diagrams**,** DRAM Controller

- Basic I/O Interfacing :Parallel I/O, I/O port address decoding, 8255A PPI programming, Operation modes, Interface examples. Timer Interfacing : 8254 PIT, Timing applications. Serial I/O Interface **:**Asynchronous communication, EIA RS232 standard, UART 16650, Interface examples.
- Interrupts :Interrupt driven I/O, Software & Hardware interrupts, Interrupt processing, 8259A PIC programming, cascading, Interrupt examples.
- Direct Memory Access : DMA Controlled I/O, 8237 DMA Controller, Disk Memory Systems- Floppy disk, Hard disk, optical disk memory systems
- Bus Interfaces :PC bus standards & interfaces – PCI, USB, Firewire, AGP

8. **Class/Laboratory Schedule**

   3 lecture hours per week. Each lecture hour is 50 minutes. 3 lab hours per week.

9. **Course Contribution to Meet the Professional Component**

This course is tightly integrated with a lab component which exposes the student to various aspects of microprocessor engineering including signal analysis, design & fabrication of medium-sized 80x86 microprocessor based system, manual wiring, testing, and hardware troubleshooting, and conducting I/O interfacing experiments using professional processor kits.

10. **Relationship to Program Outcomes**

    This course supports the following seven program outcomes out of the outcomes required by ABET Criterion 3 for accrediting computer engineering programs.

    Outcome 1: Ability to apply knowledge of mathematics, probability, and engineering in microprocessor based system design. **[ABET Criterion 3a]**

    Outcome 2: Ability to design and conduct experiments related to microprocessor based system design and to analyze their outcomes. **[ABET Criterion 3b]**

    Outcome 3: Ability to design, debug and test a small scale microprocessor system. **[ABET Criterion 3c]**

    Outcome 4: Ability to function as an effective team member **[ABET Criterion 3d]**

    Outcome 5: Ability to identify, formulate, and solve engineering problems in microprocessor based system design. **[ABET Criterion 3e]**

    Outcome 6: Ability to use design tools for microprocessor system design, test and evaluation. **[ABET Criterion 3k]**

    Outcome 7: Ability to engage in self-learning. **[ABET Criterion 3i]**

11. **Prepared by**: Dr. Abdul Rahim Naseer,

COURSE SYLLABUS

1. **Department, Number and Course Title**

   Department: Computer Engineering

   Course Number: COE 308

   Course Title: Computer Architecture

2. **Design:** Required Course

3. **Catalog Description**

   Memory management and cache memory. Integer and floating point arithmetic. Instruction and arithmetic pipelining, superscalar architecture. Reduced Instruction Set Computers. Parallel architectures and interconnection networks.

4. **Prerequisite(s)**

   Digital Design Lab (COE 203) and Computer Organization and Assembly Language (COE 205)

5. **Textbook(s) and/or other Required Material**

   David A. Patterson and John L. Hennessy, *Computer Organization & Design: The Hardware/Software Interface*, 3rd Edition, Morgan Kaufmann.

6. **Course Objectives**

   After successfully completing the course, students will be able to

   - Analyze MIPS assembly language code.
   - Describe and apply integer and floating-point representations and arithmetic.
   - Compute the execution time, average CPI, and speedup for improvements.
   - Design the datapath and control logic of simple pipelined/non-pipelined CPUs.
   - Analyze and compare the performance of different CPU designs.
   - Analyze the impact of caches and memory organization on performance.

7. **Topics Covered**

   - Instruction set architecture versus Organization, Components, Abstraction, Technology trends, Chip manufacturing process.
   - Instruction set design, Instruction formats, Addressing modes, CISC versus RISC, Writing MIPS assembly language code.
   - CPU performance and metrics, CPI, MIPS as a metric, Amdahl's law, Benchmarks, Performance of recent processors.
   - Computer arithmetic, Integer multiplication and division, Floating-point and IEEE 754 standard, Floating-point addition and multiplication, Rounding.
   - Processor design, Register transfer, Datapath components, Clocking, Single cycle and multicycle datapath, Control signals, Control unit, Performance.

- Instruction pipelining, MIPS 5-stage pipelined datapath, Control, Performance, Hazards, Stall and forwarding, Compiler scheduling, Branch prediction.
- Memory hierarchy, DRAM and SRAM, Locality, Cache memory organization, Cache misses, Write policy, Block replacement, Cache performance.
- Virtual memory, Page tables and TLB, Virtual/physical caches.
- I/O subsystem and devices, Disk operation and performance, RAID, Buses, Bus operation, DMA, I/O performance.
- Introduction to multiprocessors, Shared-memory, Cache coherence, Message-passing, Interconnection networks.

8. **Class/Laboratory Schedule**

   3 lecture hours per week. Each lecture hour is 50 minutes.

9. **Course Contribution to Meet the Professional Component**

   This course emphasizes the use of MIPS assembly language tools such as the SPIM and MARS software simulators to develop, analyze, and debug MIPS assembly language programs. It also emphasizes the use of simulators for the design and the simulation of the datapath and control of a processor. The course project is intended to build the students' ability to design, implement, simulate, and test the operation of a simple pipelined processor.

10. **Relationship to Program Outcomes**

    This course supports the following five program outcomes out of the outcomes required by ABET Criterion 3 for accrediting computer engineering programs.

    Outcome 1: Ability to apply knowledge of mathematics, probability, and statistics in computer performance evaluation. **[ABET Criterion 3a and 3L]**

    Outcome 2: Ability to design the datapath and control of a processor. **[ABET Criterion 3c]**

    Outcome 3: Ability to identify, formulate, and solve computer architecture problems. [**ABET Criterion 3e**]

    Outcome 4: Ability to use simulator tools. [**ABET Criterion 3k**]

    Outcome 5: Ability to engage in self-learning. [**ABET Criterion 3i**]

11. Prepared by: Dr. Muhamed F. Mudawar, November 7, 2006.

COURSE SYLLABUS

1. **Department, Number and Course Title**

   Department: Computer Engineering

   Course Number: COE 341

   Course Title: Data and Computer Communications

2. **Design:** Required Course

3. **Catalog Description**

   Introduction to data communication. Overview of the OSI model. Frequency response, bandwidth, filtering and noise. Fourier series and Fourier transform. Information theory concepts: Nyquist's theorem, Shannon's and Sampling theorems. Analog and digital modulation techniques. Pulse Code Modulation (PCM). Communication systems circuits and devices. Data encoding. Physical layer protocols. Data link control (point to point communication, design issues, link management, error control, flow control). Multiplexing and switching.

4. **Prerequisite**

   Calculus II (MATH 102)

5. **Textbook(s) and/or other Required Material**

   Data and Computer Communication, William Stalling, Prentice Hall International, 8th Edition.

6. **Course Objectives**

   After successfully completing the course, students will be able to:

   - Appreciate the importance of data communication standards, protocols, and protocol architectures.
   - Describe fundamental concepts in communications, including signal spectrum, power spectral density, effective bandwidth, filtering, signal to noise ratio, channel capacity, and error rate.
   - Compare and contrast various types of transmission media for both guided and guided propagation regarding cost, transmission impairments and applications.
   - Identify trade offs governing the choice of analog/digital and synchronous/asynchronous transmission techniques and different signal encoding and modulation schemes.
   - Analyze and design simple communication links using guided and unguided media, hardware for generating CRC error detection codes and performing error detection, HDLC flow and error control mechanisms, and basic PCM and Delta modulation systems.
   - Compare and contrast different multiplexing techniques, e.g. FDM, WDM, TDM, and statistical TDM.

7. **Topics Covered**

- ***Communication and Networking Models*:** Communication Model, Data Communications, Networking. The OSI model.
- ***Data Transmission*:** Concepts and terminology, Analog and Digital Data Transmission, FFT Analysis, Impairments, Nyquist and Shannon channel capacities.
- ***Guided and Wireless Transmission*:** Guided transmission media, Wireless transmission.
- ***Signal Encoding Techniques*:** Digital Data – Digital Signals, Digital Data – Analog Signals, AD/DA.
- ***Digital Data Communication Techniques*:** Asynchronous and synchronous data interface, Error types, Error Detection, Flow Control and HDLC.
- ***Multiplexing*:** Frequency division multiplexing, Time division multiplexing (synchronous and statistical), Asymmetric digital subscriber line (ASDL).

8. **Class/Laboratory Schedule:** 3 lecture hours per week.

9. **Course Contribution to Meet the Professional Component**

   This course includes a programming assignment where students use software tools to develop skills for the simulation, analysis, and design of communication processes and components.

10. **Relationship to Program Outcomes**

Outcome 1: Ability to apply knowledge of mathematics to establish basic concepts in communication engineering. **[ABET Criterion 3a]**

Outcome 2: Ability to analyze and design communication systems, processes, and components. **[ABET Criterion 3c]**

Outcome 3: Ability to identify, formulate, analyze, and solve communication engineering problems. [**ABET Criterion 3e**]

Outcome 4: Ability to use programming tools and skills for the simulation, analysis, and design of communication systems and components. [**ABET Criterion 3k**]

Outcome 5: Ability to demonstrate self learning skills and aptitudes. [**ABET Criterion 3i**]

11. **Prepared by**: Dr. Radwan E. Abdel-Aal, November 7, 2006.

COURSE SYLLABUS

1. **Department, Number and Course Title**

   Department: Computer Engineering

   Course Number: COE 344

   Course Title: Computer Networks

2. **Design:** Required Course

3. **Catalog Description**

   This course will be taught using the top-down approach. Topics covered include introduction to computer networks, OSI model, WAN and LAN design issues. Application layer design issues and protocols are discussed. Then, Transport layer design issues, protocols as well as congestion control mechanisms are presented. Socket programming is explained. An in-depth analysis is presented of the Network layer design issues, and internetworking. MAC layer design issues and protocols are presented.

4. **Prerequisite(s)**

   Data and Computer Communications (COE 341) and Probability and Statistics for Engineer and Scientists (STAT 319).

5. **Textbook(s) and/or other Required Material**

   J. Kurose & K. Ross, *Computer Networking: A Top-Down Approach Featuring the Internet*, 4rd Edition, Addison Wesley.

6. **Course Objectives**

   After successfully completing the course, students will be able to

   - Apply knowledge of mathematics, probability, and statistics to model and analyze some networking protocols.
   - Design, implement, and analyze simple computer networks.
   - Identify, formulate, and solve network engineering problems.
   - Use techniques, skills, and modern networking tools necessary for engineering practice.

7. **Topics Covered**

   - Introduction: What is the Internet, What is a protocol?, Network Edge, Network Core, Network Access, Physical Media, Delay and Loss in Packet-Switched Networks, Protocol Layers and their Service Models, Internet Backbones, NAPs and ISPs, Brief History of Computer Networking and the Internet.
   - Application Layer: Principles of Application Layer Protocols, HTTP, FTP, Electronic Mail in the Internet, DNS, P2P File Sharing.

- Transport Layer: Services and Principles, Multiplexing and Demultiplexing Applications, UDP, Principles of Reliable of Data Transfer: TCP case study, Principles of Congestion Control.
- Network Layer: Service Models, What is Inside a Router?, IP: the Internet Protocol, Routing Algorithms, Hierarchical Routing, Routing in the Internet.
- Link Layer & LANs: Link Layer: Services, Multiple Access Protocols and LANs, LAN Addresses and ARP, Ethernet, Hubs, Bridges and Switches, PPP.
- Wireless & Mobile Networks: Wireless Links & Network Characteristics, CDMA, Wireless LANs: IEEE 802.11, WPAN & Bluetooth, Introduction to mobile networking.

8. **Class/Laboratory Schedule**

   3 lecture hours and 3 laboratory hours per week. Each lecture hour is 50 minutes.

9. **Course Contribution to Meet the Professional Component**

   This course lays the ground for subsequent courses in the program on networking. It includes a laboratory where students use software and hardware tools to develop skills for the design, implementation, and analysis of computer networks.

10. **Relationship to Program Outcomes**

    This course supports the following five program outcomes out of the outcomes required by ABET Criterion 3 for accrediting computer engineering programs.

    Outcome 1: Ability to apply knowledge of mathematics, probability, and statistics to model and analyze some networking protocols. **[ABET Criterion 3a]**

    Outcome 2: Ability to design, implement, and analyze simple computer networks. **[ABET Criterion 3b]**

    Outcome 3: Ability to identify, formulate, and solve network engineering problems. [**ABET Criterion 3e**]

    Outcome 4: Knowledge of contemporary issues in computer networks. [**ABET Criterion 3j**]

    Outcome 5: Ability to use techniques, skills, and modern networking tools necessary for engineering practice. [**ABET Criterion 3k**]

11. **Prepared by**: Dr. Marwan H. Abu-Amara, November 11, 2006.

COURSE SYLLABUS

1. **Department, Number and Course Title**

   Department: Computer Engineering

   Course Number: COE 351

   Course Title: Cooperative Work (Required for BSc with COOP)

2. **Design:** Required Course

3. **Catalog Description**

   A continuous period of 28 weeks spent in industry with the purpose of acquiring practical experience in different areas of Computer Engineering. During this period, a student is exposed to the profession of Computer Engineering by working in the field. Students are required to submit a final report and give a presentation about their experience and the knowledge they gained during their Cooperative work.

4. **Prerequisite(s)**

   COE 350 if registering in the Fall semester, and ENGL 214, Completion of 90 Credits, and department requirements if registering in Spring semester.

5. **Textbook(s) and/or other Required Material**

   No format textbook. References are: KFUPM COOP Manual and departmental guidelines.

6. **Course Objectives**

   After successfully completing the course, students will be able to

   - Use hand-on experience acquired through practical work.
   - Function as an effective team member in multi-disciplinary projects.
   - Develop effective relation with co-workers.
   - Identify, formulate, and solve engineering problems.
   - Learn and search for information.
   - Document and communicate the design efforts effectively using written reports.
   - Recognize the impact of engineering solutions in a global and societal context.
   - Follow company regulations while working in the industry.

7. **Topics Covered**
   - Computer systems architecture software and hardware.
   - Digital communication system development, upgrading, and management.
   - VLSI system design and automation
   - Engineering applications of computer systems and embedded systems.

8. **Class/Laboratory Schedule**
   A continuous period of 28 weeks spent in the industry working in any of the fields of Computer Engineering. This course is equivalent to 9 credit hours in the program.

9. **Course Contribution to Meet the Professional Component**
   During this training period, the student is exposed to the profession of Computer Engineering through working in many aspects of its fields.

10. **Relationship to Program Outcomes**

    Outcome 1: Ability to apply knowledge of mathematics, science, and engineering. **[ABET Criterion 3a]**
    Outcome 2: Ability to design and conduct experiments, as well as to analyze and interpret data. **[ABET Criterion 3b]**
    Outcome 3: Ability to design a system, component, or process to meet desired needs. [**ABET Criterion 3c**]
    Outcome 4: Ability to identify, formulate, and solve engineering problems. [**ABET Criterion 3e**]
    Outcome 5: Understanding of professional and ethical responsibility. [**ABET Criterion 3f**]
    Outcome 6: Ability to communicate effectively. [**ABET Criterion 3g**]
    Outcome 7: The broad education necessary to understand the impact of engineering solutions in a global and societal context. [**ABET Criterion 3h**]
    Outcome 8: Recognition of the need for, and an ability to engage in life-long learning. [**ABET Criterion 3i**]
    Outcome 9: Knowledge of contemporary issues. [**ABET Criterion 3j**]
    Outcome 10: Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. [**ABET Criterion 3k**]
    Outcome 11: Ability to function as an effective team member [**ABET Criterion 3d**]
    Outcome 12: Ability to integrate hardware and software components in design [**ABET Criterion 3n**]

11. **Prepared by**: Dr. Mayez Al-Mouhamed, May, 2009.

COURSE SYLLABUS

1. **Department, Number and Course Title**

   Department: Computer Engineering

   Course Number: COE 360

   Course Title: Principles of VLSI Design

2. **Design:** Required Course

3. **Catalog Description**
   MOS Transistor operation and limitations, MOS digital logic circuits (NMOS & CMOS), static & dynamic logic, combinational and sequential circuits, propagation delay, transistor sizing, MOS IC fabrication, layout and design rules, stick diagrams, IC Design and Verification Tools, subsystem design and case studies, and practical considerations.

4. **Prerequisite(s)**

   Electronics I (EE 203)

5. **Textbook(s) and/or other Required Material**

   S.-M. Kang and Y. Leblebici, *CMOS Digital Integrated Circuits: Analysis and Design*, 2^{3rd} ed. Also some handouts on various topics will be used insha'Alla.

6. **Course Objectives**

   After successfully completing the course, students will be able to

   - Apply knowledge of mathematics, science, and engineering in the design, analysis and modeling of digital integrated circuits.
   - Design and conduct experiments using SPICE to characterize and optimize digital integrated circuits.
   - Design, Verify, Analyze and Evaluate the performance (speed, Power, Area, Noise margins) of different MOS digital integrated circuits for different design specifications.
   - Use various CAD tools in the design and verification of digital integrated circuits.
   - Function as an effective team member in digital integrated circuits design projects.
   - Document and communicate the design efforts effectively using written reports.

7. **Topics Covered**

   - Review of basic semiconductors properties
   - Structure, behavior and modeling of PN-junctions (Diodes)
   - Structure, behavior and modeling of Metal-Oxide-Semiconductor Transistors (MOSFETs)

- Scaling and scaling effects of MOS transistors
- Design of digital MOS Circuits; NMOS inverter, CMOS inverter, CMOS logic gates, CMOS sequential circuits
- Modeling and Simulation of CMOS integrated circuits with SPICE
- CMOS Processing Technology and Fabrication
- CMOS design rules and layout techniques, floor planning, and parasitics
- CMOS IC Design, Design styles and Case Studies

8. **Class/Laboratory Schedule**

   3 lecture hours per week. Each lecture hour is 50 minutes.

9. **Course Contribution to Meet the Professional Component**

   This course emphasizes the use of CAD tools for the design and verification of digital integrated circuits. The course project is intended to build the students' ability to design, and verify a digital integrated circuit. It also helps developing the student's ability to plan, work within a team and to communicate his design efforts.

10. **Relationship to Program Outcomes**

    Outcome 1: Ability to apply knowledge of mathematics, science, and engineering in the design, analysis and modeling of digital integrated circuits **[ABET Criterion 3a]**

    Outcome 2: Ability to design and conduct experiments using SPICE to characterize and optimize digital integrated circuits **[ABET Criterion 3b]**

    Outcome 3: Ability to Design, Verify, Analyze and Evaluate the performance (speed, Power, Area, Noise margins) of different MOS digital integrated circuits for different design specifications [**ABET Criterion 3c**]

    Outcome 4: Ability to use CAD tools in the design and verification of digital integrated circuits [**ABET Criterion 3k**]

    Outcome 5: Ability to function as an effective team member [**ABET Criterion 3d**]

    Outcome 6: Ability to document and communicate design efforts effectively using written reports [**ABET Criterion 3g**]

11. **Prepared by**: Dr. Muhammad E. Elrabaa, November 12, 2006.

COURSE SYLLABUS

1. **Department, Number and Course Title**

   Department: Computer Engineering

   Course Number: COE 390

   Course Title: Seminar

2. **Design:** Required Course

3. **Catalog Description**

   The purpose of this course is to help improve students' ability for presenting their technical work. In addition, the course emphasizes the various social and ethical responsibilities of the computing professional. It teaches students about the nature of engineering as a profession, codes of professional conduct, ethics & responsibility, and the role of professional societies. Case studies of conflict between engineering professional ethical values and external demands. The course features students participation in discussions held by faculty members and invited guests.

4. **Prerequisite:** Junior standing.

5. **Textbook(s) and/or other Required Material**

   No text is indicated.

6. **Course Objectives**

   After successfully completing the course, students will be able to

   1. To teach students the nature of engineering as a profession.
   2. To teach students the ethical and professional responsibility of engineering in the society.
   3. To improve students` technical and professional communication skills.
   4. To introduce students to different professional societies and organizations world-wide.

7. **Topics Covered**

   Each student has to submit a set of *three articles* from which an article will be selected for the student. The student will present the selected article in the class in 10 minutes. Articles should be selected covering subjects related to the computer engineering filed and should be recent. The article selected should be at least 4 pages. The recommended journals for article selection are:

   1. IEEE Spectrum

2. IEEE Computer Magazine
3. Communications of the ACM
4. IEEE Network Magazine
5. Scientific America Magazine

Students should consult with the course instructor for the selection of the article for their presentation. Subject to the approval of the course instructor, it is possible to select an article from a magazine other than those mentioned above.

8. Class/Laboratory Schedule

One 50-minute lecture per week.

9. Course Contribution to Meet the Professional Component

This course exposes the students to is Knowledge of contemporary issues, effective presentation, Knowledge of professional and ethical responsibility, Understanding the impact of engineering solutions in a global and societal context, and engaging in self-learning.

10. Relationship to Program Outcomes

This course supports the following seven program outcomes out of the outcomes required by ABET Criterion 3 for accrediting computer engineering programs.

- **Outcome 1**: Knowledge of contemporary issues.[Criterion 3j]
- **Outcome 2:** Ability to make effective presentation.[Criterion 3g]
- **Outcome 3:** Knowledge of professional and ethical responsibility. [ABET Criterion 3f]
- **Outcome 4**: Understanding the impact of engineering solutions in a global and societal context.[Criterion 3k]
- **Outcome 5**: Ability to engage in self-learning. [Criterion 3i]

11. Prepared by: Dr. Mayez Al-Mouhamed

COURSE SYLLABUS

1. **Department, Number and Course Title**

   Department: Computer Engineering

   Course Number: COE 485

   Course Title: Senior Design Project

2. **Design:** Required Course

3. **Catalog Description**
   This course is designed to give students the experience of tackling a realistic engineering problem. The intent is to show how to put theoretical knowledge gained into practical use by starting from a word description of a problem and proceeding through various design phases to end up with a practical engineering solution. Various projects are offered by COE faculty in their respective specialization areas. The project advisor guides the student in conducting feasibility study, preparation of specifications, and the methodology for the design. Detailed design and implementation of the project are carried out followed by testing, debugging, and documentation. An oral presentation and a final report are given at the end of the semester.

4. **Prerequisite(s)**
   Senior Standing

5. **Textbook(s) and/or other Required Material**

   There is no textbook for this course. The following book is used as a reference: Robert Angus and Norman Gundersen, "Planning, Performing, and Controlling Projects: Principles and Applications", Prentice-Hall, First Edition, 1997.

6. **Course Objectives**
   After successfully completing the course, students will be able to:

   - Define formal specifications from the problem statement.
   - Examine different approaches.
   - Develop new solutions that utilize fundamental scientific concepts.
   - Describe a system design from high level specifications.
   - Describe a detailed design of the required components.
   - Implement a prototype, design and conduct experiments
   - Document clearly the work by presenting original work.
   - Communicate effectively the project details orally.
   - Demonstrate team work skills, meet deadlines, and plan properly.
   - Understand the impact of a solution on the society.
   - Understand the impact of contemporary issues on a design.

7. **Topics Discussed**

   - *Project management*
   - *Engineering approach to design*

- *Design verification and testing*
- *Work habits*
- *Project Documentation*
- *Oral Presentation*

8. **Class/Laboratory Schedule:** One lecture hour (50 minutes) per week.

9. **Course Contribution to Meet the Professional Component**

   The course allows the students to learn more about the methodology and phases of conducting a design project. Students examine different approaches, conduct a feasibility study, and prepare specifications. They also carry out a detailed design and implementation of the project, followed by testing, debugging, and documentation, and oral presentation.

10. **Relationship to Program Outcomes**
    - **Outcome 1:** Ability to apply knowledge of mathematics, science, and engineering. **[ABET Criterion 3a]**
    - **Outcome 2:** Ability to design and conduct experiments, as well as to analyze and interpret data. **[ABET Criterion 3b]**
    - **Outcome 3:** Ability to design a system, component, or process to meet desired needs. [**ABET Criterion 3c**]
    - **Outcome 4:** Ability to identify, formulate, and solve engineering problems. [**ABET Criterion 3e**]
    - **Outcome 5:** Understanding of professional and ethical responsibility. [**ABET Criterion 3f**]
    - **Outcome 6:** Ability to communicate effectively. [**ABET Criterion 3g**]
    - **Outcome 7:** The broad education necessary to understand the impact of engineering solutions in a global and societal context. [**ABET Criterion 3h**]
    - **Outcome 8:** Recognition of the need for, and an ability to engage in life-long learning. [**ABET Criterion 3i**]
    - **Outcome 9:** Knowledge of contemporary issues. [**ABET Criterion 3j**]
    - **Outcome 10:** Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. [**ABET Criterion 3k**]
    - **Outcome 11:** Ability to function as an effective team member [**ABET Criterion 3d**]
    - **Outcome 12:** Ability to integrate hardware and software components in design [**ABET Criterion 3n**]

11. **Prepared by**: Dr. Mohammed H. Sqalli, April 10, 2007.

COURSE SYLLABUS

1. **Department, Number and Course Title**

   Department: Computer Engineering

   Course Number: COE 400

   Course Title: System Design Laboratory (1-6-3)

2. **Design:** Required Course

3. **Catalog Description**

   This is a project-oriented course to integrate student's hardware and software knowledge through the design, implementation, debugging and documentation of one major system. Hardware design cycle, design principles: top down/bottom up, divide and conquer, and modular design techniques. Students are expected to work in teams to come up with a final working system where they learn to make design decision weighing various engineering factors and tradeoffs, e.g cost/performance, and hardware/software.

4. **Prerequisite(s)**

   Microcomputer System Design (COE 305)

5. **Textbook(s) and/or other Required Material**

   No text is indicated.

6. **Course Objectives**

   After successfully completing the course, students will be able to

   1. To introduce microcontrollers and their use in embedded systems.
   2. To understand architecture, programming and serial and parallel interface of microcontrollers.
   3. To learn how to design and build an embedded system for customized applications.
   4. To understand how to interface a microcontroller to a host using serial and parallel standards.
   5. To learn how is the microcontroller used in data logging in an industrial oriented application.
   6. To learn the art of engineering design methods, design tradeoffs and software/ hardware interdependency, in addition to commercial product development.

7. **Topics Covered**

   1. The architecture of microcontrollers, differences between microcontrollers and microprocessors, microcontroller assembly programs, including serial routines for communications between a microcontroller and a remote host.
   2. Interface a microcontroller to various sensors, switches, actuators, and motors, pulse width modulation technique used in motor control and energy saving.

3. Interface a microcontroller to a multi-drop network of microcontrollers and PCs using different serial and other industry-grade protocols.
4. Design and implement the final product using printed circuit board tools following engineering and economical standards.
5. Write an advanced high level software driver interface between the PC and the final hardware product. Target embedded system a web enabled application. To show capability to use engineering methods including design tradeoffs in designing and packaging the final product.

8. Class/Laboratory Schedule

One 50-minute lecture and two labs, each lab is 3-hour, per week.

9. Course Contribution to Meet the Professional Component

This course is tightly integrated with a lab component which exposes the student to various aspects of embedded system engineering including analysis, design, fabrication, manual wiring, testing, and hardware troubleshooting, and conducting I/O interfacing experiments.

10. Relationship to Program Outcomes

Outcome 1: Ability to apply knowledge of mathematics, science, and engineering. **[ABET Criterion 3a]**

Outcome 2: Ability to design and conduct experiments, as well as to analyze and interpret data. **[ABET Criterion 3b]**

Outcome 3: Ability to design a system, component, or process to meet desired needs. [**ABET Criterion 3c**]

Outcome 4: Ability to identify, formulate, and solve engineering problems. [**ABET Criterion 3e**]

Outcome 5: Understanding of professional and ethical responsibility[**ABET Criterion 3f**]

Outcome 6: Ability to communicate effectively. [**ABET Criterion 3g**]

Outcome 7: The broad education necessary to understand the impact of engineering solutions in a global and societal context. [**ABET Criterion 3h**]

Outcome 8: Recognition of the need for, and an ability to engage in life-long learning. [**ABET Criterion 3i**]

Outcome 9: Knowledge of contemporary issues. [**ABET Criterion 3j**]

Outcome 10: Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. [**ABET Criterion 3k**]

Outcome 11: Ability to function as an effective team member [**ABET Criterion 3d**]

Outcome 12: Ability to integrate hardware and software components in design [**ABET Criterion 3n**]

11. Prepared by: Dr. Mayez Al-Mouhamed

Appendix B

FACULTY RESUMES

Curriculum Vitae

1. Name: Adnan Abdul-Aziz Gutub
2. Rank: Chairman & Associate Professor, Computer Engineering Department
3. Degrees with fields, institution, and date
   B.Sc. in Electrical Engineering, KFUPM, January 1995.

   M.Sc. in Computer Engineering, KFUPM, June 1998.

   Ph.D. in Electrical & Computer Eng., Oregon State University, Sept. 2002.
4. Number of years of service at KFUPM: 14 years
   Original appointment: 1995, Graduate Assistant

   Dates of advancement in rank: 1999, Lecturer

   2002, Assistant Professor

   2007, Associate Professor
5. Other related experiences – teaching, industrial etc.
   Taught: Fund. of Comp. Eng., Comp. Organ. & Assem. Lang. Prog., Microcomputer Sys. Des., Princ. VLSI Des., Senior Des. Proj., Applied Cryptosystems, Network Security Eng., University Study Skills
6. Consulting, patents etc: None
7. State(s) in which registered: None
8. Principal publications in last five years:
   1. A. Gutub, "High Speed Hardware Architecture to Compute GF(p) Montgomery Inversion with Scalability Features", *IET (IEE) Proceedings Computers and Digital Techniques* , Pages: 389-396 , July 2007.
   2. A. Gutub, "Area Flexible GF(2k) Elliptic Curve Cryptography Coprocessor", *International Arab Journal of Information Technology (IAJIT),* Vol. 4, No. 1, Pages: 1-10, January 2007.
   3. A. Gutub, "Fast 160-Bits GF(p) Elliptic Curve Crypto Hardware of High-Radix Scalable Multipliers", *International Arab Journal of Information Technology (IAJIT),* Vol. 3, No. 4, Pages: 342-349, October 2006.
   4. A. Gutub, "Merging GF(p) Elliptic Curve Point Adding and Doubling on Pipelined VLSI Cryptographic ASIC Architecture" , *International Journal of Computer Science and Network Security (IJCSNS),* Vol.6, No.3A, Pages: 44 – 52, March 2006.
   5. A. Gutub, M.K. Ibrahim, and A. Kayali., "Pipelining GF(P) Elliptic Curve Cryptography Computation", *The 4th ACS/IEEE International Conference on Computer Systems and Applications (AICCSA-06),* Pages: 93 – 99, American University of Sharjah (AUS), United Arab Emirates, March 8-11, 2006.
9. Scientific and professional societies of which a member:

1. Cryptography Group & Security Research Group, KFUPM.
2. Bio-Inspired Intelligent Systems Team, Brunel University, UK.
3. Cryptographic Hardware and Embedded Systems Research Group.
4. Information Security Lab., Oregon State University, USA.
5. Pervasive Systems Centre, University of Southampton, UK.

10. Honors and awards:
    1. Awarded Ten Years Certificate of Service by the Rector of KFUPM, 2005.
    2. Awarded British Council Summer research Grants two times held at Brunel University (2005) and University of Southampton (2008).

11. Institutional and professional service in the last five years
    Delivered Summer Workshops on:

    - Cryptography for Computer Security Applications", 2007.
    - Brain Storming", 2007, 2008.

    Institutional Professional development activities in the last five years.
    Attended several specialized development workshops, such as:

    1. ADKAR Change Management for Executives & Managers, January 2009.
    2. Chairman Duties & Leadership Role, 8 April 2008
    3. Preparing leaders for specialized Gifted Students Programs, April 2007.
    4. Improving teaching skills in KFUPM at Sept. of 2005, 2006.
    5. The Role of Academic Chairman in the 21st Century, 2006.
    6. Research Enhancement for Junior Faculty Members, 2006.

12. Percentage of time available for research or scholarly activity; 10%

    Percentage of time committed to the program (department chairman); 75%

Curriculum Vitae

1. Name : Mayez Abdullah Al-Mouhamed
2. Rank : Professor, Computer Engineering Department
3. Degrees with fields, institution, and date

   B.Sc. in Electrical Engineering, ___ University of Paris XI, France, May 1975
   M.Sc. in Electrical Engineering, ___University of Paris XI, France, Sep 1977
   Ph.D. in Electrical Engineering, ___ University of Paris XI, France, Jan 1982
4. Number of years of service at KFUPM: 26 years

   Original appointment: January, 1983, Assistant Professor
   Dates of advancement in: January, 1990, Associate Professor
   June, 2000, Professor
   Visiting Asso. Prof. Univ. of California Irvine, Comp. Science, 1993
5. Other related experiences – teaching, industrial etc.

   Taught Computer Architecture, Parallel Algorithms and Architectures, Computer networks and Data Communication, Computer Vision, and Robotics.
6. Consulting, patents etc.
   1. "A Closed Loop Robotic Control", European Patent Office, No 83400154.7, 1983
   2. "A Robotics Force Sensor", European Patent Office, No 83400153.9, 1983
7. Professional Engineer in New York State (if not applicable, say 'none'): None
8. Principal publications in last five years
   1. Mayez A. Al-Mouhamed, Mohammad Nazeeruddin, and Nesar Merah, Design and Analysis of Force Feedback in Telerobotics, under review with the IEEE T. on Industrial Electronics, March, 2006.
   2. M. Al-Mouhamed, O. Toker, A. Iqbal, A Multi-Threaded Distributed Telerobotic Framework, IEEE T.on Mechatronics, February, 2006
   3. M. Al-Mouhamed, O. Toker, and A-K Al-Harthy, A 3D Vision-Based Man-Machine Interface For Hand-Controlled Telerobot, IEEE T. on Industrial. Electronics, 52:1, 2005, pp. 306-319.
   4. M. Al-Mouhamed, Array Organization in Parallel Memories, Inter. J. of Parallel Programming (IJPP), Vol 32, No.2, April, 2004, pp.123-163.
   5. M. Al-Mouhamed and U. F. Siddiqi, Performance Evaluation of Auctions WLAN for RoboCup Multi-Robot COOPeration, 7th ACS/IEEE International Conference on Comp. Sys. and Apps. (AICCSA-2009), February, 2009.
   6. M. A. Al-Mouhamed, M. Nazeeruddin, and N. Merah, Force-Based Compliant Behaviors to Augment Telerobotics, 4th Inter. AUS Symposium on Mechatronics, March 26-29, 2007, Sharjah, UAE.
   7. M. Al-Mouhamed, O. Toker, A. Iqbal, A Distributed Framework for Relaying Stereo Vision for Telerobotics, IEEE Inter. Conf. on Pervasive Services, Lebanon, 2004, pp. 221-225.
   8. M. Al-Mouhamed, A Scalable Family of High-Speed Switch Architectures, IEEE Inter. Conf. On Electronics, Circuits and Systems (2003), pp. 32-35.
9. Scientific and professional societies

   Member, IEEE Robotics and Automation society.

Member, Editorial Board, Inter. Journal of Parallel Programming (IJPP), USA.

10. Honors and awards.
    - Recipient of KACST First Degree, Golden Certificate for Excellence in Research, K.S.A., January 2007.
    - Recipient of the Winning Award of the CCSE Student Project Innovation Award on the "Design of an Internet Robot", KFUPM, June, 2006.
    - Recipient of the "College of Computer Science and Engineering Excellence Award in Teaching for the COE Department", KFUPM, Dhahran 31261, K.S.A., June 2006.
    - Recipient of the "College of Computer Science and Engineering Excellence Award in Student Project", KFUPM, Dhahran 31261, K.S.A., June 2006.
    - Recipient of the "College of Computer Science and Engineering Excellence Award in Muti-Disciplinary Research", KFUPM, Dhahran 31261, K.S.A., June 2003.
    - Recipient of the "King Fahd University of Petroleum and Minerals Distinguished Short Course Award", KFUPM, Dhahran 31261, K.S.A., June 2002.

11. Institutional and professional service in the last five years
    1. Coordinator for PhD Preliminary and Comprehensive Exams in Computer Architecture.
    2. Member of COE Curriculum Self-Assessment Committee, COE, KFUPM, 2002.
    3. Chairman, COE ABET committee for Preparing the Self-Study Report and implementing EC 2K, 2006-2009.

    Professional development activities in the last five years.

    a. Workshop on KFUPM-ARAMCO ICT Collaboration Workshop Program, 10th of March 2009, RI, KFUPM.
    b. Attended a Three-Day Workshop on "Program Continuous Quality Improvement" by Dr. Mahesh Aggrawal from the Mechanical Eng. Dept. at the Gannon University USA, , KFUPM, September 14-15-16, 2008.
    c. Attended a two-day workshop on "Peer Consultation in Teaching" Saturday 3-4, May 2008 from 4:00 pm to 8:00 pm. The workshop is offered by the TLC-DAD-KFUPM and Professor Sergio Piccinin.
    d. Attended the Intel Workshop on "High Performance Computing Software Training". KFUPM, May 21-24, 2006.
    e. Attended the Workshop on "Engineering Design", by McMahon, Knecht, Baluch, Loughlin, Al-Qutub, and Youcef-Toumi. KFUPM, April 11-12, 2006.

12. Percentage of time available for research or scholarly activity; 30%

    Percentage of time committed to the program; 60%

Curriculum Vitae

1. Name : Radwan El-Said Abdel-Aal
2. Rank : Professor, Computer Engineering Department
3. Degrees with fields, institution, and date:

   B.Sc. in Electrical Engineering, Electronics & Communications, Cairo University, June 1972

   M.Sc. in Aviation Electronics, Canfield Institute of Technology, UK, October 74

   Ph.D. in Electronic & Electrical Engineering, Strathcyde University, UK, June 1983
4. Number of years of service at KFUPM: 24 years

   Original appointment: November, 1985, Research Scientist III, Research Institute

   Dates of advancement in Rank: May, 90, Research Scientist II, Research Institute

   June, 95, Research Scientist I, Research Institute

   November, 2006, Professor, Computer Eng. Dept.
5. Other related experiences – teaching, industrial etc.:

   Sep 04 - Aug 05 Physics Dept, KFUPM, Associate Professor

   Sep 83 - March 85 Strathclyde University, Research Fellow, Glasgow, UK

   Sep 79 - July 83 Strathclyde University, Research Assistant Glasgow, UK

   June 78 -Aug 79 Sunderland Polytechnic, Research Assistant, Tyne and Wear,UK
6. Consulting, patents etc.: None
7. State(s) in which registered: Chartered Engineer, MIEE, UK, 1984
8. Principal publications in last five years:

   1. R.E. Abdel-Aal, M.A. Elhadidy, S.M. Shaahid, Modeling and forecasting the mean hourly wind speed time series using GMDH-based abductive networks, Renewable Energy 34 (2009) 1686–1699.

   2. Radwan E. Abdel-Aal and El-Sayed M. El-Alfy, Constructing optimal educational tests using GMDH-based item ranking and selection, *Neurocomputing* (2009) 72, pp. 1184-1197.

   3. Abdel-Aal, R. E., "Univariate modeling and forecasting of monthly energy demand time seriesn using abductive and neural networks " Computers and Industrial Engineering (2008), 54 (4), pp. 903-917.

   4. El-Sayed M. El-Alfy and Radwan E. Abdel-Aal, "Construction and analysis of educational tests using abductive machine learning", Computers and Education, (2008) 51, pp. 1–16.

   5. Abdel-Aal, R. E., "Predictive Modeling of Mercury Speciation in Combustion Flue Gases Using GMDH-Based Abductive Networks," Journal of Fuel Processing Technology, Vol. 88, 2007, pp. 483-491.

   6. Abdel-Aal, R. E., Abdel-Halim, M. R. E. and Abdel-Aal, S., "Improving the classification of multiple disorders with problem decomposition," Journal of Biomedical Informatics Vol. 39, 2006, pp. 612-625.

7. Abdel-Aal, R. E., "Modeling and forecasting electric daily peak loads using abductive networks," Elec. Power and Energy Systems, Vol. 28 (2006), pp. 133-141.

8. Abdel-Aal, R. E., "Improved classification of medical data using abductive network committees trained on different feature subsets," Computer Methods and Programs in Boimedicine, Vol. 80 (2005), pp. 141-153.

9. Abdel-Aal, R. E., "GMDH-based feature ranking and selection for improved classification of medical data," J. of Biomedical Info., Vol. 38 (2005), pp. 456-468.

10. Abdel-Aal, R. E., "Improving electric load forecasts using network committees", Electric Power Systems Research. Vol. 74 (2005), pp. 83–94.

11. Abdel-Aal, R. E., "Hourly temperature forecasting using abductive networks," Engineering Applications of Artificial Intelligence, Vol. 17 (2004), pp. 543-556.

12. Abdel-Aal, R. E., "Abductive network committees for improved classification of medical data," Methods of Information in Medicine, Vol. 43 (2004), pp. 192-201.

13. Abdel-Aal, R. E., "Short term hourly load forecasting using abductive networks," IEEE Transactions on Power Systems, Vol. 19 (2004), pp. 164-173.

9. Scientific and professional societies of which a member

- Member, IEEE, USA, since 1984
- Member, IEE, UK, 1984-1996
- Member, Engineers Syndicate, Egypt, since 1993

10. Honors and awards.

- Listed in Marquis Who's Who in the World, 2007.
- The British Council Fees Award, UK, 1973/74.
- The British Royal Aeronautical Society Prize for best marks in the MSc Aviation Electronics course at the Cranfield Institute of Technology, UK, 1973.

11. Institutional and professional service in the last five years

- "Predicting log properties from seismic data using abductive networks", Funded research project completed for Saudi Aramco, Value SR 250,000, 2005-6, Co-investigator.
- Developed WebCT-based course material for COE 342/341, COE 305, and COE 202.
- Developed a new lab manual for PHYS 303 lab (Semester 041) containing 14 new experimental setups and procedures.
- Reviewed research papers for several journals, including: IEEE Trans. Power Systems, Energy, Neural Computing and Applications, Electrical Power and Energy Systems, Artificial Intelligence in Medicine, and Medical Engineering and Physics.

Professional development activities in the last five years.

- Attended/contributed to several conferences.
- Attended several workshop organized by the DAD workshops.

12. Percentage of time available for research or scholarly activity; 20%

Percentage of time committed to the program; 60%

Curriculum Vitae

1. Name: Mohammed, Sadiq Sait
2. Rank: Professor, Computer Engineering Department
3. Degrees with fields, institution, and date
   B.E. in Electronics Engineering, Bangalore University, India, May 1981
   M.S. in Electrical Engineering, KFUPM, Saudi Arabia, August 1983
   Ph.D. in Electrical Engineering, KFUPM, Saudi Arabia, November 1986
4. Number of years of service at KFUPM: 29 years

Original appointment:	1981-1983,	Research Assistant
Dates of advancement in rank:	1983-1986,	Lecturer
	1987-1992,	Assistant Professor
	1992-1998,	Associate Professor
	1998-present,	Professor
	2000-2004,	Chairman, Com. Engg. Dept.
	2005-Present,	Director, ITC

5. Other related experiences – teaching, industrial etc.
   Teaching: Taught several undergrad and graduate courses in COE Department related to Digital Logic, VLSI CAD, Internet Information Systems, Synthesis, and Computer Communication.
6. Consulting, patents etc.
   Patent (Pending): (with Rehan Sami and Abdul Waheed): “Content-Aware Congestion Control for Software MPLS Routers”
7. State(s) in which registered: none
8. Principal publications in last five years
   1. Sadiq M. Sait and Junaid A. Khan, "Fast Fuzzy Force-Directed Simulated Evolution metaheuristic for Multiobjective VLSI cell placement", European Journal of Operational Research (Submitted October 2004).
   2. Sadiq M. Sait, Khalid M. Al-Tawil, and Syed Ali Hussain, "E-Commerce in Saudi Arabia: Adoption and Perspectives", Australian Journal of Information (AJIS) Systems, Vol. 12 (1), pages 54-74, September 2004.
   3. Sadiq M. Sait, Khalid M. Al-Tawil, Salman A. Khan and Mohammed Faheemuddin, "The Use and Effect of Internet on General Education in Saudi Arabia", Journal of Technology, Pedagogy and Education (TPEd), UK. (Submitted, March 2004).
   4. Aiman H. El-Maleh, S. Saqib Khursheed, and Sadiq M. Sait, "Efficient Static Compaction Techniques for Sequential Circuits based on Reverse Order Restoration Based and Test Relaxation", Submitted to IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (June 2005).
   5. Sadiq M. Sait, and Mahmood R. Minhas, "SimE/TS fuzzy hybrid for multiobjective VLSI placement", Electronics Letters, Volume 42, Issue 6, 16 March 2006 Page(s):364 - 365.
   6. Sadiq M. Sait, Mahmood R. Minhas, and Junaid A. Khan. ``Performance and Low Power Driven VLSI Standard Cell Placement using Tabu Search", IEEE Congress on Evolutionary Computation", May 2002, Honolulu, Hawaii, USA, pp 372-377.

7. Sadiq M. Sait, Syed Hussain Ali, Khalid M. Al-Tawil and Syed Sanaullah, "Trends in Internet Usage & its effects in Saudi Arabia", ICASE World Conference on Science & Technology Education, pp 692-700, Penang Malaysia, April 2003.
8. Aamir A. Farooqui, Vojin G. Oklobdzija, Sadiq M. Sait. Area-Time Optimal Adder with Relative Placement Generator. IEEE International Symposium on Circuits and Systems", Vol V, 141-144, Bangkok, Thailand, May 2003.
9. Sadiq M. Sait and Muhammad Al-Ismail, "Enhanced Simulated Evolution algorithm for Digital Circuit Design yielding faster execution in a larger solution space", IEEE Congress on Evolutionary Computation (CEC), Portland, Oregon, USA, June 2004.
10. Sadiq M. Sait, Mustafa I. Ali and Ali M. Zaidi, "Multiobjective VLSI Cell Placement using Distributed Simulated Evolution Algorithm", International Symposium on Circuits and Systems, (ISCAS 05), Kobe, Japan, May 2005.

9. Scientific and professional societies of which a member
    1. Senior Member, IEEE.
    2. Member, IEEE Computer Society, IEEE CAS Society
    3. Member, Saudi Computer Society
10. Honors and awards.
    1. Nominee for the 'Distinguished Teacher Award' three times, and received the award once (from 'King Fahd University of Petroleum & Minerals'), in 1995.
    2. Received the 'Distinguished Researcher Award' three times from 'King Fahd University of Petroleum & Minerals', in 1990, 1994, and 1999.
    3. Nominated by the Department of Computer Engineering for the 'Best Advisor Award' two times.
    4. Editor of 'Arabian Journal for Science and Engineering (AJSE)' for Computer Science & Engineering 1992-present.
11. Institutional and professional service in the last five years

    Director: ITC Department, COE Department Plan Committee, Academic Committee, Member: KASP (King Abdullah Science Park), ERP (Raed Project) and Aafaq project

    Professional development activities in the last five years.

    Aiman El-Maleh and Sadiq M. Sait. 'Efficient Test Relaxation-Based Static Test Compaction Techniques for Combinational and Sequential Circuits'. Co-Investigator of KFUPM Research Committee sponsored. Proposal accepted, August 2004, Two year Project, IP.

12. Percentage of time available for research or scholarly activity; 20%
    Percentage of time committed to the program; 60%

Curriculum Vitae

1. Name : Aiman Helmi El-Maleh
2. Rank : Associate Professor, Computer Engineering Department
3. Degrees with fields, institution, and date

   B.Sc. in Computer Engineering, King Fahd Univ. of Petroleum & Minerals, April 1989
   M.A.Sc. in Electrical Engineering, University of Victoria, July 1991
   Ph.D. in Electrical Engineering, McGill University, August 1995
4. Number of years of service at KFUPM: 11 years
   Original appointment: Sep., 1998, Assistant Professor
5. Other related experiences – teaching, industrial etc.

   Member of Scientific Staff
   05/95 to 08/98, Mentor Graphics Corporation, Wilsonville, USA.

6. Consulting, patents etc.
   Aiman H. El-Maleh, Wojciech Maly, Thomas E. Marchok, Janusz Rajski, “Test Pattern Generation for an Electronic Circuit Using a Transformed Circuit Description,” US Patent 5,528,604.
7. State(s) in which registered: None.

8. Principal publications in last five years

1) Aiman El-Maleh, Mustafa I. Ali and Ahmad A. Al-Yamani, "Reconfigurable Broadcast Scan Compression Using Relaxation Based Test Vector Decomposition," IET Computers & Digital Techniques, March 2009, Vol. 3, Iss. 2, pp. 143–161.

2) Esa Alghonaim, Aiman El-Maleh and Adnan Al-Andalusi, "NEW TECHNIQUE FOR IMPROVING PERFORMANCE OF LDPC CODES IN THE PRESENCE OF TRAPPING SETS," EURASIP Journal on Wireless Communications and Networking, Article ID 362897, 12 pages, 2008. doi:10.1155/2008/362897 (A special issue on Advances in Error Control Coding Techniques).

3) Aiman El-Maleh, "Efficient Test Compression Technique Based on Block Merging," IET Comput. Digit. Tech., 2008, Vol. 2, No. 5, pp. 327–335.

4) Aiman El-Maleh, “Test Data Compression for System-on-a-Chip using Extended Frequency-Directed Run-Length (EFDR) Code,” IET Computers & Digital Techniques, 2008, Vol. 2, No. 3, pp. 155–163.

5) Aiman H. El-Maleh, Bashir M. Al-Hashimi and Aissa Melouki, "Transistor-Level Based Defect-Tolerance for Reliable Nanoelectronics," The sixth ACS/IEEE International Conference on Computer Systems and Applications (AICCSA-08), Doha, Qatar, 2008 pp. 53-60.

6) Esa Al-Ghonaim, Aiman H. El-Maleh, and Adnan Andalusi, "Using input/output queues to increase LDPC decoder performance," The sixth ACS/IEEE International Conference on Computer Systems and Applications (AICCSA-08), Doha, Qatar, 2008, pp. 304-308.

7) Aiman El-Maleh, Saqib Khurshid, “Efficient Test Compaction for Combinational Circuits Based on Fault Detection Count-Directed Clustering,” IET Computers & Digital Techniques, 2007, 1, (4), pp. 364–368.

8) Esa Alghonaim, Aiman El-Maleh and Adnan Al-Andalusi, " PARALLEL COMPUTING PLATFORM FOR EVALUATING LDPC CODES PERFORMANCE," IEEE International Conference on Signal Processing and Communications (ICSPC 2007), November 2007, Dubai, United Arab Emirates, pp. 157- 160

9) Aiman El-Maleh, Saqib Khursheed, and Sadiq Sait, "Static Compaction Techniques for Sequential Circuits Based on Reverse Order Restoration and Test Relaxation" IEEE TRANSACTIONS ON COMPUTER-AIDED DESIGN OF INTEGRATED CIRCUITS AND SYSTEMS, VOL. 25, NO. 11, pp. 2556-2564, NOVEMBER 2006.

10) Sadiq M. Sait, Aiman H. El-Maleh, and Raslan H Al-Abaji, "Evolutionary Algorithms for VLSI Multiobjective Netlist Partitioning," ENGINEERING APPLICATIONS OF ARTIFICIAL INTELLIGENCE 19 (3): 257-268 APR 2006.

11) Aiman El-Maleh, Sadiq Sait, and Syed Shazli, "Evolutionary Algorithms for State Justification in Sequential Automatic Test Pattern Generation," ENGINEERING INTELLIGENT SYSTEMS FOR ELECTRICAL ENGINEERING AND COMMUNICATIONS 13 (1): 15-21, MAR 2005.

12) Aiman El-Maleh and Khaled Al-Utaibi, "An Efficient Test Relaxation Technique for Synchronous Sequential Circuits," IEEE Transactions on Computer Aided Design of Integrated Circuits, Vol. 23, No. 6, pp. 933-940, June 2004

11. Scientific and professional societies of which a member

Member, IEEE Computer Society.

Honors and awards.

Distinguished Teaching & Advising Award: College of Computer Sciences & Engineering, 2001/2002.

DATE Best Paper Award: Winner of the best paper award for the most outstanding contribution in the field of Test at the Design Automation and Test in Europe (DATE) Conference, 1995.

Institutional and professional service in the last five years: I supervised nine Master computer engineering students. I have five funded research projects. I served as a member of University Research committee and I participated in the evaluation process of research proposals. I was a chairman and a member of Joint COE/ICS Programs Coordination Committee and I participated in the preparation of PHD comprehensive exam. I was also a member of Curriculum revision committee revising the computer engineering curriculum. I chaired the assessment committee responsible for the assessment of computer engineering courses. I have acted as a technical reviewer for many international journals and conferences.

Professional development activities in the last five years: I attended a workshop on Peer Consultation program to get the necessary training to act as a peer consultant. I also attended several workshops on course design and good teaching and learning.

12. Percentage of time available for research or scholarly activity; 30%

Percentage of time committed to the program; 70%

Curriculum Vitae

1. Name : Alaaeldin A. M. Amin
2. Rank : Associate Professor, Computer Engineering Department
3. Degrees with fields, institution, and date

   B.Sc. in Electrical Engineering, Cairo University, July 1974
   M.Sc. in Electrical Engineering, Cairo University, June 1977
   Ph.D. in Computer Engineering, University of Utah, June 1987
4. Number of years of service at KFUPM: 21 years

   Original appointment: September, 1988, Assistant Professor

   Dates of advancement in: October 1993, Assoc. Professor
5. Other related experiences –
   - Over 8 years of industrial experience at National Semiconductor Corporation, a large and leading multi-national Integrated Circuit manufacturer with headquarters in Santa Clara California (Silicon Valley) 1980 - 1988.
   - Wide experience in the field of VLSI Integrated Circuit design in general and in MOS Memory Design in particular., including product performance specification, process technology definition, circuit design and layout, logic and device level simulation, test requirements, circuit debugging and troubleshooting as well as final testing.

   Projects Accomplished / worked on:

   1. Design of a CMOS SRAM-Based FPGA Test chip,
   2. Design of 32K CMOS EPROM, 3. Design of 64K NMOS EPROM,
   4. Design of 256K NMOS DRAM, 5. Design of 256K CMOS EPROM, (Took over as team leader)
   6. Design of 1MB EPROM, and (Took over as team leader)
   7. Design of 256K CMOS *FLASH EEPROM* (Team Leader)
6. Patents
   i. Amin, A. and Brennan, J. "*Electrically reprogrammable EPROM cell with merged transistor and optimum area*," US Patent No. 5,455,793, October 3, 1995
   ii. Amin, A. and Brennan, J. "Electrically reprogrammable EPROM cell with merged transistor and optimum area," US Patent No. 5,293,328, March 8, 1994 and European Patent Office; No. 2310776.7-, February 1993 , and.
   iii. Amin, A. and Emoto, Bernard "*A High Speed Sense Amplifier for EPROM Single Transistor Memory Cell*," US Patent No. 5,117,394, May 26, 1992; European Patent No. 89121444.7-, December 1989.
   iv. Amin, A. "*A Novel Architecture for Flash Erase EPROM Memory*," US. Patent No. 4,999,812, March 1991; European Patent No. 89121391.0-, December 1989.
   v. Amin, Alaaeldin and Mahmoud, Muhammad "*Apparatus And Method For High-Speed Modulo Multiplication And Division*," final revised version sent to patent lawyer to be filed soon.

vi. Amin, Alaaeldin and Shinwari, M. W. "*A Novel High-Radix Multiplier-Divider*," manuscript sent to patent lawyer for patent-style re-write.

vii. Al-Somani Turki F. and Amin, Alaaeldin "*An Efficient Elliptic Curve Scalar Multiplication with Multilevel Resistant Against Power Analysis*" initial patentability search under way

7. State(s) in which registered None
8. Principal publications in last five years

1. T. F. Al-Somani and A. A. Amin, "High Performance Elliptic Curve Scalar Multiplication with Resistance against Power Analysis Attacks," *Journal of Applied Sciences*, Volume 8 (24), 2008, pp. 4587-4594.

2. Alaaeldin Amin, "Automatic Placement of Micropipeline Standard Cells," WSEAS Trans. on Circuits and Systems, Volume 7, issue 11, Nov. 2008, pp. 932-941.

3. A.A. Amin, "Area-Efficient High-Speed Carry chain," *the IET* Electronics Letters, Volume 43, Issue 23, November 8 2007, pp. 1258-1260.

4. Alaaeldin Amin, "A High-Speed Self-Timed Carry-Skip Adder," IEE Proceedings - Circuits, Devices and Systems, Volume 153, Issue 6 , December 2006, pp. 574-582.

5. T. Al-Somani, and A. Amin, "Hardware Implementations of GF(2^m) Arithmetic using Normal Basis," Journal of Applied Sciences Vol. 6, No. 6, 2006, pp. 1362-1372.

7. Turki F. Al-Somani and Alaaeldin Amin, "High Performance Elliptic Curve Point Operations with Pipelined GF(2^m) Field Multiplier," Proceedings of the 6th IEEE/ACS International Conference on Computer Systems and Applications (AICCSA-08), March 31-April 4, 2008, pp. 82-88.

8. Turki F. Al-Somani and Alaaeldin Amin, "An Efficient High Performance Scalar Multiplication Method with Resistance against Timing Attacks," Proceedings of the 6th IEEE/ACS International Conference on Computer Systems and Applications (AICCSA-08), March 31-April 4, 2008, pp. 860-865.

9. Scientific and professional societies of which a member

1. Member, IEEE, 2. Member, IEICE

10. Honors and awards.

- Two-times winner of College of Computer Science and Engineering *Distinguished Teaching Award*

11. Professional development activities in the last five years.

- Principal investigator for 500,000SR externally-funded research grant
- Supervised 1- PhD and served as committee member of another dissertation.
- Supervised 4 MS theses and served as committee member on many others

12. Percentage of time available for research or scholarly activity; 30%
Percentage of time committed to the program; 60%

Curriculum Vitae

1. Name : Muhammad E. S. Elrabaa
2. Rank : Associate Professor, Computer Engineering Department

3. Degrees with fields, institution, and date

B.Sc. in Computer Engineering, Kuwait University, Kuwait, May 1989
M.Sc. in Electrical & Computer Engineering, University of Waterloo, Waterloo, CANADA, October 1991
Ph.D. in E& CE, University of Waterloo, October 1995

4. Number of years of service at KFUPM: 8 years
Original appointment: Sept., 2001, Assistant Professor

5. Other related experiences – teaching, industrial etc.:
Sept. 1998 – August 2001: Assistant Professor, Electrical Eng. Dept., United Arab Emirates University, Al-Ain, UAE.
Sept. 1995 – Aug. 1998: Senior Component Design Engineer, Intel Corporation, Portland, Oregon, USA.
Sept. 1989 - Sept. 1995: Research Assistant, VLSI Research Group, University of Waterloo, Waterloo, Ontario, CANADA.
May 1990 - Dec. 1994: Teaching Assistant, University of Waterloo.
May 1989 - Sept. 1989: Research Assistant, Kuwait University, Kuwait.

6. Consulting, patents etc.:
United States Patent # 5,602,774, awarded in Feb. 11th, 1997: M. S. Elrabaa and M. I. Elmasry, "Low-Power BiCMOS/ECL SRAM"
United States Patent # 5,966,032, awarded in Oct. 12th, 1999: M. S. Elrabaa, M. I. Elmasry, and D. S. Malhi, "A BiCMOS Transceiver for Gigahertz Operation"
Jan. 1992 - Dec. 1994: As a contracted Researcher, with the Microelectronics Center, NorTel Ltd., Ottawa, CANADA.
May 1992-Apr. 1993: As a contracted Circuit Designer, with the Canadian Microelectronics Corporation (CMC), CANADA.

7. State(s) in which registered:none

8. Principal publications in last five years:
1. Muhammad E. S. Elrabaa, "Portable Clock Recovery Circuits (CRCs) For On-Chip and Off-Chip Serial Data Communication," Arabian Journal for Science and Engineering (AJSE), pp. 109-117, December issue, 2007.
2. A. Bouhraoua and Muhammad E. S. Elrabaa, "An Efficient Network-ON-Chip Architecture Based on Fat-Tree (FT) Topology," Arabian Journal for Science and Engineering (AJSE), pp. 13-26, December issue, 2007.
3. M. Elrabaa, “An All-Digital Clock Frequency Capturing Circuitry For NRZ Data Communications,” Accepted in the13th IEEE International Conference on Electronics, Circuits and Systems (ICECS 2006), Dec. 2006, Nice, France
4. M. Elrabaa, “A Portable Clock Recovery Circuit (CRC) For Systems-On-Chip Serial Data Communication,” Accepted in ICM06.
5. M. Elrabaa, “A Digital Clock Re-Timing Circuit for On-Chip Source-Synchronous Serial Links,” Accepted in ICM06.
6. A. Bouhraoua and M. Elrabaa, “An Efficient Network-on-Chip Architecture Based on Modified Bidirectional Multi-Stage Interconnection Network (MIN) Topology,” Accepted in ICM06.

7. A. Bouhraoua and M. Elrabaa, “A High-Throughput Network-on-Chip Architecture for Systems-on-Chip Interconnect,” Accepted in the Int. Symp. on System-on-Chip (SOC06), November 2006, Tampere, Finland.

8. Muhammad E. S. Elrabaa, "A New Static Differential CMOS Logic with Superior Low Power Performance," Analog Integrated Circuits and Signal Processing, Vol. 43, No. 2, pp. 183-190, May 2005.

9. M. Elrabaa, "A New Static Differential CMOS Logic with Superior Low Power Performance," Analog Int. Cir. and Sig. Proc., P. 183, May 2005.

9. Scientific and professional societies of which a member

Member of Institute of Electrical and Electronics Engineers (IEEE)

Saudi Society of Electrical Engineers (SSEE)

10. Honors and awards: N/A

11. Institutional and professional service in the last five years:

Delivered the following seminars in the period 2002-2007 for KFUPM students, faculty and high school students; "Assigning Letter Grades Based on Clustering: A Relative Grading Approach", "Design of VLSI Integrated Circuits", "Introducing Multi-Phase Design into a Junior-Level Course" and "Product Development: A Short Guide"

Professional development activities in the last five years:

Attended several workshop on developing teaching skills at KFUPM given by international experts on the subject.

12. Percentage of time available for research or scholarly activity; 30%

Percentage of time committed to the program; 70%

Curriculum Vitae

1. Name : Abdelhafid Bouhraoua

2. Rank : Assistant Professor, Computer Engineering Department

3. Degrees with fields, institution, and date
   B.Sc. in Computer Engineering, INI, Algeria, October 1989
   M.Sc. in Computer Engineering, University of Paris, June 1993
   Ph.D. in Computer Engineering, University of Paris, May 1998

4. Number of years of service at KFUPM: 04 years

   Original appointment: Feb., 2005, Assistant Professor

5. Other related experiences – teaching, industrial etc.
   Jan. 04 – Feb. 05 Director of Systems Integration and Test; Lambda Optical Systems Corp.; Reston, VA, USA
   Oct. 01 – Nov. 03 Senior ASIC Designer and Chip Architect; Zarlink Semiconductor; Ottawa, Canada
   June 00 – Oct. 01 Senior ASIC Design Engineer, Applied Microcircuits Corporation; Ottawa, Canada
   Nov. 99 – June 00 System Verification Lead, Celox Networks; St.Louis, MO, USA
   April 98 – Oct. 99 Software Architect; Sprint Corp.; Kansas City, KS, USA
   Oct. 93 – Dec. 97 Research and Teacher Assistant; ASIM Lab; University of Paris VI; Paris, France.
   Oct. 92 – June 93 Teacher Assistant; ASIM Lab; University of Paris VI; Paris, France

6. Consulting, patents etc.

8. State(s) in which registered: None

9. Principal publications in last five years:

- A. Bouhraoua and Metub Al-Shammari, "A Fundamentally Secure Payment Device Interfaced to Regular PCs", *Accepted at the 2008 IEEE Region 5 Conference,* 17-20 April, 2008, Kansas City, USA.
- A. Bouhraoua and Mohammed E.S. El-Rabaa, "Addressing Heterogeneous Bandwidth Requirements in Modified Fat-Tree Networks-on-Chips", *Proceedings of the 4th International Symposium on Electronic Design Test and Applications (DELTA-08),* 23-25 January 2008, Hong Kong, China.
- A. Bouhraoua and Mohammed E.S. El-Rabaa, "An Efficient Network-on-Chip Architecture Based on the Fat Tree (FT) Topology", *Arabian Journal of Science and Engineering (AJSE), Special Issue on Microelectronics,* December 2007, pp 13-26.

- A. Bouhraoua, "Design Feasibility Study For a 500 Gbits/s AES Cypher/Decypher Engine", *Proceedings of the International Conference on Microelectronics (ICM'06)*, 16-19 December 2006, Dhahran, Saudi Arabia
- A. Bouhraoua and Mohammed E.S. El-Rabaa, "An Efficient Network-on-Chip Architecture Based on the Fat Tree (FT) Topology", *Proceedings of the International Conference on Microelectronics (ICM'06)*, 16-19 December 2006, Dhahran, Saudi Arabia
- A. Bouhraoua and Mohammed E.S. El-Rabaa, "A High-Throughput Network-on-Chip Architecture for Systems-on-Chip Interconnect," *Proceedings of the International Symposium on System-on-Chip* (SOC06), 14-16 November 2006, Tampere, Finland, pp 1-4.

10. Scientific and professional societies of which a member: Member IEEE.

11. Honors and awards.
    - College of Computer Science and Engineering (CCSE) Senior Design Project Supervision Award, June 2007
    - Best Student Paper Award, IEEE Computer Society at PDCS'96, Dijon.
    - Seymour Cray 1st Prize Laureate from CRAY Computer Company as a member of Alliance designers team, 1994 (see http://www-asim.lip6.fr/team/distinctions/cray94/)

12. Percentage of time available for research or scholarly activity; 30%
    Percentage of time committed to the program; 70%

Curriculum Vitae

1. Name : Ahmad Almulhem
2. Rank : Assistant Professor, Computer Engineering Department
3. Degrees with fields, institution, and date
   - B.Sc. in Electrical Engineering, KFUPM, June. 1991.
   - M.Sc. in Computer Engineering, KFUPM, June 1996.
   - Ph.D. in Electrical and Computer Eng., University of Victoria, Canada, Nov. 2007.
4. Number of years of service at KFUPM: 16 years
   Original appointment: 1993, Graduate Assistant
   Dates of advancement in rank: 1996, Lecturer
   2007, Assistant Professor
5. Other related experiences – teaching, industrial etc.
   Industrial Experience: Operation Engineer, Saudi Aramco (1991-1992)
   Teaching: COE 203: Digital Logic Design, COE 449: Network Security Engineering, COE599/CSE699: COE SEMINAR
6. Consulting, patents etc: None
7. State(s) in which registered: None
8. Principal publications in last five years:
   - Ahmad Almulhem and Issa Traore, Detecting Connection-Chains: A Data Mining Approach, to appear in International Journal of Network Security.
   - Ahmad Almulhem and Issa Traore, Profiling Distributed Connection Chains, International Journal of Communication Networks and Distributed Systems 2008 - Vol. 1, No.1 pp. 4 – 18.
   - Ahmed Awad, Issa Traore and Ahmad Almulhem, Digital Fingerprinting Based on Keystroke Dynamics, International Symposium on Human Aspects of Information Security & Assurance (HAISA 2008), Plymouth, UK, July 2008
   - Ahmad Almulhem and Issa Traore, A Survey of Connection-Chains Detection Techniques, 2007 IEEE Pacific Rim Conference on Communications, Computers and Signal Processing, Victoria, B.C., Canada, Aug 2007.
   - Ahmad Almulhem and Issa Traore, Mining and Detecting Connection-Chains in Network Traffic, Joint iTrust and PST Conferences on Privacy, Trust Management and Security, Moncton, Canada, Jul 2007.
   - Ahmad Almulhem and Issa Traore, Profiling Spatial Hackers, Department of Electrical and Computer Engineering, University of Victoria, Technical Report ECE-06.1, 2006.

- Ahmad Almulhem and Issa Traore, Experience with Engineering a Network Forensics System, The International Conference on Information Networking, Jeju, Korea, Jan 2005.
- Ahmad Almulhem and Issa Traore, Experience with Engineering a Network Forensics System, Lecture Notes in Computer Science, Springer-Verlag, 2005.
- Ahmad Almulhem and Issa Traore, Connection-Chains: A Review and Taxonomy, Department of Electrical and Computer Engineering, University of Victoria, Technical Report ECE-05.4, 2005.

9. Scientific and professional societies of which a member
   - The Information Security and Object Technology (ISOT) Research Lab, University of Victoria, Canada

10. Honors and awards.
    - Nominated by University of Victoria for the best PhD dissertation (2007).
    - Awarded sponsorship by KFUPM for PhD studies (2003-2007).
    - Highest honors in Electrical Engineering, KFUPM (1991).

11. Institutional and professional service in the last five years
    - Chair of the Teaching Excellence Award committee for the year 2008.
    - Committee member of the National Commission for Academic Accreditation and Assessment.
    - Committee member of the KFUPM VIP Reception for 2007-2008.
    - Technical committee member of the 13th Saudi Technical Exchange Meeting (2008)
    - A reviewer for several conferences and journals in the area of computer security.
    - Advising and assessment of COOP students.

    Institutional Professional development activities in the last five years.
    Developed a new computer security course (COE 449)

12. Percentage of time available for research or scholarly activity; 20%
    Percentage of time committed to the program; 60%

Curriculum Vitae

1. Name : Ahmad A. Al-Yamani
2. Rank : Assistant Professor, Computer Engineering Department
3. Degrees with fields, institution, and date

B.Sc. in Computer Engineering, KFUPM, May 1997

M.Sc. in Computer Engineering, KFUPM, May 1999

M.Sc. in Management Sciences and Engineering, Stanford University, April 2004

Ph.D. in Electrical Engineering, Stanford University, June 2004

4. Number of years of service at KFUPM: 12 years

Original appointment: June, 1997, Graduate Assistant

Dates of advancement in rank: June, 1999, Lecturer

Oct, 2005, Assistant Professor

5. Other related experiences – teaching, industrial etc.

June 04 – Aug 06, Consulting Assistant Prof., Elect. Engg, Stanford University

April 04 – Aug 06, Adjunct Faculty, Electrical Engg, Santa Clara University, CA

June 04 – July 05, Staff Engineer, Advanced Dev. Labs, LSI Logic, Milpitas, CA

6. Consulting, patents etc.

- Grinchuk, M., A. A. Al-Yamani, and E. Chmelar, "Methods for using checksums in X-tolerant test response compaction in scan-based testing of integrated circuits," Filed with USPTO, May 18, 2005, Application number 11/131,990. Issued by USPTO, February 5, 2008, Patent number 7,328,386.

- Grinchuk, M., A. A. Al-Yamani, and E. Chmelar, "System And Method For Implementing Postponed Quasi-Masking Test Output Compression In Integrated Circuit," Filed with USPTO, Dec 16, 2004, Application number 11/013,641, Issued by USPTO, April 24, 2007, Patent number 7,210,083.

- Al-Yamani, A. A., M. Grinchuk, and E. Chmelar, "Segmented addressable scan architecture and method for implementing scan-based testing of integrated circuits," Filed with USPTO, March 31, 2005, Application number 11/097,936, Issued by USPTO, April 17, 2007, Patent number 7,206,983.

7.State(s) in which registered: None

8.Principal publications in last five years

- El-Maleh, A., M. Imran, and A. Al-Yamani, “Broadcast Scan Compression Using Relaxation Based Test Vector Decomposition,” Accepted for IET Computers and Digital Techniques (IET CDT).
- Al-Yamani, A., "Enhanced Digital Test and Characterization of Controlled-Impedance Buffers," Arabian Journal for Science and Engineering (AJSE), Vol. 33, No. 1B, pp. 131-141, April 2008.
- Al-Yamani, A., N. Devta-Prasanna, and A. Gunda, “A Comparative Study of Centralized and Distributed Compatibility-Based Test Data Compression,” IET Computers and Digital Techniques (IET CDT), Vol. 2, No. 2, pp. 108-117, March 2008.
- Al-Yamani, A., S. Ramsundar, and D. Pradhan, "A Defect Tolerance Scheme for Nanotechnology Circuits," IEEE Transactions on Circuits and Systems-I (TCAS-I), Vol. 54, No. 11, pp. 2402-2409, Sep. 2007
- Al-Yamani, A., "Energy-Delay Efficient Test," Accepted for IET Computers and Digital Techniques (IET CDT), Vol. 1, No. 5, pp. 653-658, Sep 2007.

• Al-Yamani, A., N. Devta-Prasanna, E. Chmelar, M. Grinchuk, and A. Gunda, “Scan Test Cost and Power Reduction through Systematic Scan Reconfiguration,” IEEE Transactions on Computer-Aided Design (TCAD), 26(5), pp. 907-918, May 2007.

• Al-Yamani, A.A, and E.J. McCluskey, “Test Chip Experimental Results on High Level Structural Test,” ACM Transactions on Design Automation of Electronic Systems (TODAES’05), Vol. 10, No. 4, pp. 690-701, October 2005. (INVITED)

• Al-Yamani, A.A., S. Mitra, and E.J. McCluskey, "Optimized Reseeding by Seed Ordering and Encoding," IEEE Transactions on Computer-Aided Design (TCAD'05), 24(2), pp. 264-271, February 2005.

• Argyrides, C., A. Al-Yamani, C. Lisboa, L. Carro, and D. Pradhan, “Increasing Memory Yield in Future Technologies through Innovative Design,” IEEE International Symposium on Quality Electronics Design (ISQED’09), San Jose, CA, March 16-18, 2009.

• El-Maleh, A., Mustafa Ali, and A. Al-Yamani, "A Reconfigurable Broadcast Scan Compression Scheme Using Relaxation Based Test Vector Decomposition," 16th IEEE Asian Test Symposium (ATS'07), Beijing, China, Oct. 8-11, 2007.

9. Scientific and professional societies of which a member
    - Member, Institute of Electrical and Electronics Engineers, IEEE
    - Member, Computer Society, IEEE
    - Member, Saudi Council of Engineers
10. Honors and awards.
    - Selected to appear in Who's Who of Emerging Leaders
    - Winner of the British Council summer research award for 2006.
    - Patent champion of LSI Logic, 2005.
    - First recipient of Gerald Gordon international award from the test technology technical council, 2003;
    - Two awards for contribution to pacific northwest test workshop 2002, and 2003
    - Over 15 research publication awards from the Saudi Cultural Mission in Washington, 2000 – 05.
11. Institutional and professional service in the last five years
    - Aafaq (Strategic plan for higher education in Saudi Arabia)
    - Information and tommunication technology committee (University)
    - E-government committee (University)
    - IT client companies committee (University)
    - The organizing committee for the 12th and the 13th IEEE Pacific Northwest Test Workshop (BAST’03 and BAST’04).
    - The program committee for 14th IEEE Pacific Northwest Test Workshop.
12. Percentage of time available for research or scholarly activity; 20%

    Percentage of time committed to the program; 60%

Curriculum Vitae

1. Name : Ashraf S. Hasan Mahmoud
2. Rank : Assistant Professor, Computer Engineering Department
3. Degrees with fields, institution, and date
   B.Sc. in Electrical and Computer Engineering, Kuwait University, May 1990
   M.ENG. in Engineering Physics (Computer Systems), McMaster University, June 1992
   Ph.D. in Systems and Computer Engineering, Carleton University, Feb 1997
4. Number of years of service at KFUPM: 6 years
   Original appointment: Sept, 2002, Assistant Professor
5. Previous experiences:
   May 1997 – Aug 2002: Senior radio systems designer – Research and development division at Nortel Networks – Ottawa, Canada
   Dec 1996 – May 1997: TRIO research fellow – Carleton University, Ottawa – Canada
   Sept 1992-Dec 1996: Teaching/Research assistant – Systems and Computer Engineering Department, Carleton University, Ottawa – Canada
6. Consulting, patents etc.

   1997-1998 – Consultation for Bell South through Nortel Networks – Design and performance evaluation for voice traffic over wireless ATM network.

   2001-2002 – Consultation for systems division at Nortel Networks – performance evaluation of radio resource allocation algorithms for 3G mobile network

   2006-2007 – Consultation for Saudi Telecom Company – Network Simulation Tools (OPNET).

   2007-2009 – Consultation for Saudi Telecom Company – WiMAX Subchannel Scheduling and Capacity Characterization.

   Ashraf Mahmoud, Osama Kubbar, Miroslav Budic, “System And Method For Maximizing Throughput in a Telecommunications System,” United States Patent 7,301,904 – November 2007.

7. Recent publications:
   A. Mahmoud, S. Al-Qahtani, “A Framework of Call Admission Control Procedures for Integrated Services Mobile Wireless Networks,” (in press) Arabic Journal for Science and Engineering (AJSE), 2009.
   T. Sheltami, A. Mahmoud, M. Abu-Amara, “An Ad hoc Wireless Sensor Network for Telemedicine Applications,” (in press) Arabic Journal for Science and Engineering (AJSE), 2009.
   A. Mahmoud, “Framework for Analysis of Transmission Rate Scheduling for Wireless CDMA Data Networks,” Journal of Wireless Personal Communications, No. 46, No. 4, pp. 413–427, September 2008.
   S. Mahmoud, A. Mahmoud, “The Use of Hartley Transform in OCR with application to Printed Arabic Character Recognition,” Pattern Analysis & Applications Journal, July 2008.

A. Mahmoud, "Cell Site Power Characterization for Multi-rate Wireless CDMA Data Networks Using Lognormal Approximation," Journal of Communications, Vol. 3, No. 5, pp. 47-53, October 2008.

Ashraf S. Mahmoud, "Downlink Traffic Power Characterization for Multi-Rate Wireless CDMA Data Networks," To appear in proceedings of the IEEE 66th 2007 Fall Vehicular Technology Conference (VTC), 1-3 October 2007, Baltimore, Maryland, USA, pp. 1539-1542, 2007.

Abdul-Aziz Al-Helali, Ashraf Mahmoud, Talal Al-Kharobi, Tarek Sheltami, "Analysis of Handoff Delay Components for Mobile IP-Based 3GPP UMTS/WLAN Interworking Architecture," to appear in IEEE 23rd International Conference on Advanced Information Networking and Applications (AINA-09), Bradford, UK, May 26-29, 2009.

Abdul-Aziz Al-Helali, Ashraf Mahmoud, Talal Al-Kharobi, Tarek Sheltami, "Characterization of Vertical Handoff Delay for Mobile IP Based 3G/WLAN Integrated Networks," to appear in IEEE 69th Vehicular Technology Conference (VTC2009-Spring), 26-29 April 2009, Barcelona, Spain.

8. Scientific and professional societies of which a member
    1. Member, Institute of Electrical and Electronics Engineers (IEEE).
    2. Member, Jordan Engineers Association.
9. Honors and awards.
    - Received distinguished teaching award for college of computer sciences and engineering – KFUPM – May 2007.
10. Institutional and professional service in the last five years

    2002-2009: Actively participating in program assessment and curriculum design and revision for the computer engineering department at KFUPM - Dhahran, Saudi Arabia.

    1997-2002: Provided technical support and consultations for external and internal customers for Nortel Networks – Ottawa, Canada.
11. Professional development activities in the last five years.

    Sept 2008: Teaching & Learning Center of the Deanship of Academic Development – Linking Research and Teaching (Workshop) and Informal Learning (Workshop).

    Sept 2007: Teaching & Learning Center of the Deanship of Academic Development – Teaching for Learning (Workshop).

    Sept 2006: Teaching & Learning Center of the Deanship of Academic Development - Using Course Design to Create more Significant Learning Experiences for Students (Workshop).

    Sept 2006: Teaching & Learning Center of the Deanship of Academic Development - Good Learning and Good Teaching: How do we promote more of it? (Workshop).

12. Percentage of time available for research or scholarly activity; 30%

    Percentage of time committed to the program; 70%

Curriculum Vitae

1. Name : Basem Almadani
2. Rank : Assistant Professor, Computer Engineering Department
3. Degrees with fields, institution, and date
   B.Sc. in Computer Engineering, KFUPM, 1997

   Ph.D. in Industrial Automation, Montan University Leoben, Leoben, Austria, 2005
4. Number of years of service at KFUPM: 2 years

   Rank : Assistant Professor, 2007
5. Other related experiences – teaching, industrial etc.
   None
6. Consulting, patents etc.
   None
7. State(s) in which registered
   None
8. Principal publications in last five years
9. Scientific and professional societies of which a member
10. Honors and awards.
11. Institutional and professional service in the last five years
12. Percentage of time available for research or scholarly activity; 20%

    Percentage of time committed to the program; 60%

Curriculum Vitae

1. Name : Marwan Hassan Abu-Amara
2. Rank : Assistant Professor, Computer Engineering Department
3. Degrees with fields, institution, and date:
   B.Sc. in Computer Engineering, Kuwait University, May 1989
   M.Sc. in Electrical & Computer Eng., Texas A&M University, December 1991
   Ph.D. in Electrical & Computer Eng., Texas A&M University, May 1995
4. Number of years of service at KFUPM: 6 years
   Original appointment: September, 2003, Assistant Professor
   Dates of advancement in: N/A
   Rank: September, 2009, Assistant Professor
5. Other related experiences – teaching, industrial etc.:
   Senior Technical Advisor for Wireless Network Eng., Nortel Networks, 1998 – 2003
   Wireless CDMA System Design Architect, Nortel Networks, 1995 – 1997
   Lecturer, Electrical Engineering Department, Texas A&M University, 1992 – 1995
6. Consulting, patents etc.:
   "Reducing the Rate of Registration in CDMA-based Mobile Networks," US Patent Pending, 11641709, December 20, 2006.
   "Method of Non-Intrusive Control of Mobile Device," with A. Mahmoud, US Patent Pending, 11599457, November 15, 2006.
   "CDMA Inter–Mobile Switching Center Soft Hand–Off," with S. Sides, A. Jalali, J. Boppana, S. Doctor, US Patent # (6,173,183), 2001, US Patent # (5,930,714), 1999
   Funded project: Internet Access Denial by International Internet Service Providers: Analysis and Counter Measures, The 1st Five Year National Plan for Science and Technology, 2009 – 2011, Approved.
   Funded project: Saudi Honeynet Project, The 1st Five Year National Plan for Science and Technology, 2009 – 2011, Approved.
   Funded project: WiMAX Subchannel Scheduling and Capacity Characterization, Saudi Telecom Company (STC), December 2007 – December 2008, Completed.
   Funded project: Next Generation Networks Workshop, Saudi Telecom Company (STC), December 2007 – December 2008, Completed.
   Funded project: Wireless Local Area Networks Integration for Mobile Networks Operators, KFUPM Fast Track, 2005, Ongoing.
7. State(s) in which registered: none
8. Principal publications in last five years:
   M. Abu-Amara, A. Mahmoud, T. Sheltami, A. Al-Shahrani, K. Al-Otaibi, S. Rehman, T. Anwar, "Performance of UMTS/WLAN Integration at Hot-Spot Locations Using OPNET," Proc. of 4th IEEE-GCC Conference, November 2007, Bahrain, 5 pages.
   S. Asadullah, A. Mahmoud, M. Abu-Amara, T. Sheltami, "Vertical Handoff Characterization for SIP and mSCTP Based UMTS-WLAN Integration Solutions," Proc. of 4th IEEE-GCC Conference, November 2007, Bahrain, 5 pages.

T. Sheltami, A. Mahmoud, M. Abu-Amara, "An Ad hoc Wireless Sensor Network for Telemedicine Applications," Arabian Journal for Science and Engineering (AJSE), Volume 32, No. 1B, April 2007, pp. 131-143.

T. Landolsi and M. Abu-Amara, "CDMA Access Channel Performance under Idle–Mode Ping–Pong Effect in Inter–MSC Handoffs," Proceedings of 3rd Intl. Symp. on Wireless Communication Systems, September 2006, Valencia, pp. 585–587.

M. Abu-Amara, S. Sait, A. Subhan, "A Heuristics Based Approach for Cellular Mobile Network Planning," Proc. of 2006 Intl. Wireless Communications & Mobile Computing Conference, July 2006, Vancouver, p. 79.

A. Mahmoud, M. Abu-Amara, T. Sheltami, E. Rahman, J. Jaffar, "WLAN Integration for Future Generation Mobile Network Operators – A Case Study," Proc. of 18th National Computer Conference, March 2006, Riyadh, pp. 47–54.

T. Sheltami, A. Mahmoud, M. Abu-Amara, "Warning and Monitoring System using Sensor Networks," Proc. of 18th National Computer Conference, March 2006, Riyadh, pp. 63–68.

A. Mahmoud, T. Sheltami, M. Abu-Amara, "Wireless Sensor Network Implementation for Mobile Patient," Proc. of 3rd IEEE–GCC Conference, March 2006, Bahrain.

T. Sheltami, A. Mahmoud, M. Abu-Amara, "Telecare Monitoring System Based on Wireless Sensor Network," Intl. Journal of Computer Science and Network Security, Vol. 5, No. 12, December 2005, pp. 66–74.

A. Mahmoud and M. Abu-Amara, "Performance of Inter–Base Station Handoff for 3G CDMA Networks," Proc. of 1st Intl. Conference on Modeling, Simulation and Applied Optimization, Sharjah, U.A.E., February 2005.

M. Abu-Amara, "Minimum Traffic Inter–BS SHO Boundary Selection Algorithm for CDMA–Based Wireless Networks," Proc. of 2004 IEEE Radio and Wireless Conference, Atlanta, Georgia, September 2004, pp. 51–53.

9. Scientific and professional societies of which a member: none

10. Honors and awards:

CCSE Award of Merit for Distinguished Innovation Project, KFUPM, 2006.

President and CEO's Top Talent Award, Nortel Networks, 2000 and 2001.

Circle of Excellence – Sales Support Award, Nortel Networks, 1999.

Wireless Net. President's Award of Excellence in Technology, Nortel Networks, 1998.

Award of Merit – CDMA Product Positioning, Nortel Networks, 1998.

11. Institutional and professional service in the last five years:

Member, COE ABET Committee, 2008–present

Chairman, COE ABET Assessment Committee, 2006–present

Chairman, COE Labs Committee, 2006–2008

Chairman, CCSE Continuing Education Committee, 2005–2006

Chairman, CCSE Infrastructure Committee, 2004–2005

Professional development activities in the last five years:

DAD Workshop on Developing Educational Objectives & Learning Outcomes, King Fahd University of Petroleum & Minerals, September 19, 2006.

12. Percentage of time available for research or scholarly activity; 30%

Percentage of time committed to the program; 70%

Curriculum Vitae

1. Name : Mohammed Houssaini Sqalli
2. Rank : Assistant Professor, Computer Engineering Department
3. Degrees with fields, institution, and date

   "Ingenieur d'Etat" in Computer Science, Ecole Mohammadia d'Ingenieurs, Morocco, July 1992.

   M.Sc. in Computer Science, University of New Hampshire, USA, December 1996.

   Ph.D. in Engineering – Systems Design, University of New Hampshire, USA, May 2002.
4. Number of years of service at KFUPM: 7 years

   Original appointment: August, 2002, Assistant Professor
5. Other related experiences – teaching, industrial etc.

- Senior Automation Testing Specialist, Siemens - Mobile - Telecom Innovation Centre, Ottawa, Canada, (Sept. 1999 – July 2002).
- Research and Project Assistant at the ATM Consortium, InterOperability Lab, University of New Hampshire, Durham, NH, USA, (May 1996 – August 1999).
- Software Engineer, Computer Science Department, Ministry of Finance, Rabat, Morocco, (1992-1994).

6. Consulting, patents etc.

Saudi Telecom Company (STC), Data Network Infrastructure and Management, 2003

7. State(s) in which registered: 'none'
8. Principal publications in last five years

[1] Sadiq M. Sait, Mohammed H. Sqalli, and Syed Asadullah, "Optimizing OSPF Routing Using Accelerated Iterative Heuristic". The 8th WSEAS International Conference on Artificial Intelligence, Knowledge Engineering, and Databases (AIKED'09), February 21-23, 2009, University of Cambridge, Cambridge, UK.

[2] K. Salah, K. Sattar, M. Sqalli, and Ehab Al-Shaer, "A Probing Technique for Discovering Last-Matching Rules of a Network Firewall". The 5th International Conference on Innovations in Information Technology (Innovations'08), December 16-18, 2008, Al Ain, United Arab Emirates (UAE).

[3] Mohammed H. Sqalli, Sadiq M. Sait, and Syed Asadullah, "Minimizing the Number of Congested Links in OSPF Routing". The Australasian Telecommunications Networking and Application Conference (ATNAC-2008), December 7-10, 2008, Adelaide, Australia.

[4] Sadiq M. Sait, Mohammed H. Sqalli, and Mohammed Aijaz Mohiuddin, "An Evolutionary algorithm to Multi-objective OSPF Weight Setting Problem", the 19th ACS Australian Joint Conference on Artificial Intelligence (AI-2006), Hobart, Tasmania, Australia, December 4-8, 2006.

[5] Shaik Sirajuddin, and Mohammed H. Sqalli, "Distributed XML-based Network Management using JPVM". International Journal of Network Management (IJNM), John Wiley & Sons, Inc. Volume 16, Issue 4, July/August 2006, Pages: 263-277.

[6] Syed M. S. Islam, Mohammed H. Sqalli, and Sohel Khan, "Modeling and Formal Verification of DHCP Using SPIN". International Journal of Computer Science & Applications (IJCSA), Volume 3, No. 2, June 2006, Pages: 145-159.

[7] Mohammed H. Sqalli, Sadiq M. Sait, and Mohammed Aijaz Mohiuddin, "An Enhanced Estimator to Multi-objective OSPF Weight Setting Problem". The 10th

IEEE/IFIP Network Operations and Management Symposium (NOMS-2006), April 3-7, 2006, Vancouver, Canada.
[8] Mohammed H. Sqalli, and Shaik Sirajuddin, "An Adaptive Load-balancing Approach to XML-based Network Management using JPVM". The 13th IEEE International Conference on Networks (ICON 2005), November 16-18, 2005, Kuala Lumpur, Malaysia.
[9] Mohammed H. Sqalli, and Shaik Sirajuddin, "Static Weighted Load-balancing for XML-based Network Management using JPVM". The 8th IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS 2005), J. Dalmau and G. Hasegawa (Eds.): LNCS 3754, pp. 228 – 241, October 24-26, 2005, Barcelona, Spain.
[10] Syed M. S. Islam, Mohammed H. Sqalli, and Sohel Khan, "Simulation and Formal Verification of DHCP". Information and Communication Technologies International Symposium (ICTIS-2005), June 3-6, 2005, Tetouan, Morocco.
[11] Shaik Sirajuddin, and Mohammed H. Sqalli, "Comparison of CSV and DOM Tree Approaches in XML-based Network Management". The 12th IEEE International Conference on Telecommunications (ICT 2005), May 3 - 6, 2005, Cape Town, South Africa

9. Scientific and professional societies of which a member
   IEEE, IEEE Communications Society, IEEE Computer Society
   Saudi Scientific Society for Electrical Engineers (SSSEE)
   Saudi Engineering Council
10. Honors and awards.
    - Fulbright Scholarship (1994-1998) sponsored by the Moroccan-American Commission for Education and Cultural Exchange (MACECE).
    - Second prize student paper award at the Seventh International Workshop on Principles of Diagnosis (DX-96), Canada.
11. Institutional and professional service in the last five years
    TPC member of GIIC-07, ICIT-07, SSI-06.
    Refereeing of publications for journals and conferences, including: AJSE, IJNM, Elsevier Computer Communications, Wiley Publishers, SSI-06, ICT-06, ICCNMC-05, IEEE-GCC-05, and ICICS-04.
    Cisco Certified Network Academy (CCNA) instructor, 2005-2006
    Sponsoring Professor for OPNET at KFUPM, 2002-2006
12. Percentage of time available for research or scholarly activity; 30%
    Percentage of time committed to the program; 70%

Curriculum Vitae

1. Name : Muhamed Fawzi Mudawar
2. Rank : Assistant Professor, Computer Engineering Department
3. Degrees with fields, institution, and date
   B.E. in Electrical Engineering, American University in Beirut, June 1986
   M.Sc. in Computer Engineering, Syracuse University, June 1988
   Ph.D. in Computer Engineering, Syracuse University, June 1993
4. Number of years of service at KFUPM: 5 years
   Appointment: September 2004 – Present , Assistant Professor
5. Other related experiences – teaching, industrial etc.
   American University in Cairo: 1993 – 2004, Assistant Professor
   Prime Computer, USA: 1988 – 1989, Software Engineer
6. Consulting, patents etc: None
7. State(s) in which registered: None
8. Principal publications in last five years:

- Hossam I., El-Ayat K., and Mudawar M., A Locked Cache-Based Synchroniztion Protocol for CMP, *in Proceedings of the 2006 International Conference on Parallel and Distributed Processing Techniques and Applications*, June 26-29, 2006, Las Vegas, Nevada.
- Zaghloul S., Mudawar M., and Darwish M., Development of a Simultaneously Threaded Multi-Core Processor, *in proceedings of the ITI/IEEE 3rd International Conference on Information & Communication Technology*, December 5-6, 2005, Cairo, Egypt.
- Mudawar M. and Wani J., One-Level Cache Memory Design for Scalable SMT Architectures, in *Proceedings of the 17th ISCA International Conference on Parallel and Distributed Computing Systems*, September 15-17 2004, San Francisco, California.
- Mudawar M., Scalable Cache Memory Design for Large-Scale SMT Architectures, *ACM International Conference Proceedings Series, Vol 68*; also in *Proceedings of the 3rd Workshop on Memory Performance Issues: in conjunction with 31st IEEE/ACM International Symposium on Computer Architecture*, June 20-23 2004, Munich, Germany.
- Amer I., Badawy W., and Mudawwar M., Towards Low-Power Synthesis: A Common Subexpression Extraction Algorithm Under Delay Constraints, in *Proceedings of the 46th IEEE Midwest Symposium on Circuits and Systems*, December 27 – 30, 2003, Cairo, Egypt.
- Haddad H. and Mudawwar M., Corner-First Tree-Based Region Broadcasting in Mesh Networks, in *Proceedings of the 21st IASTED International Conference on Parallel and Distributed Computing and Networks*, February 10-13, 2003, Innsbruck, Austria, pages 615-620.

9. Scientific and professional societies of which a member
   - Institute of Electrical and Electronic Engineers: Computer Society.
   - Academic Computing Machinery.
   - International Society for Computers and their Applications.

- International Association of Science and Technology for Development.

10. Honors and awards: None
11. Institutional and professional service over the past two years: 2004 – 2006

- KFUPM Housing committee: policies and faculty housing allocation.
- CCSE Automation committee, chairman: new dynamic website for CCSE.
- COE Assessment committee: self assessment for Computer Engineering.
- COE Architecture group: revising and improving courses.

Professional development activities in the last five years.

International Conference on Parallel and Distributed Processing Techniques and Applications, June 26-29, 2006, Las Vegas, Nevada.
31st Annual IEEE/ACM International Symposium on Computer Architecture, June 19-23, 2004, Munich, Germany.

Thesis Supervision of the following students:
- Khaja M. Mohammed, "The Quadra Network: A New Topology for Interconnection Networks and New Broadcasting Schemes", Master Thesis, Computer Engineering department, KFUPM, December 2005.
- Soha S. Zaghloul, "Development of a Simultaneously Threaded Multi-Core Processor", Ph.D. Thesis, Cairo University, December 2005.
- Ihab Mostafa Amin Amer, "Synthesis and Optimization of Digital Systems for Low Power at Logical Level of Abstraction", Master Thesis, Computer Science Department, AUC, May 2003.
- Hadeel Youssef Samaan Haddad, "Tree-Based Regional Broadcasting in Mesh Directed Networks", Master Thesis, Computer Science Department, AUC, December 2002.

12. Percentage of time available for research or scholarly activity; 30%
    Percentage of time committed to the program; 70%

Curriculum Vitae

1. Name : Talal Mousa Alkharobi
4. Rank : Assistant Professor, Computer Engineering Department
5. Degrees with fields, institution, and date

   B.Sc. in Computer Engineering, _____ KFUPM, 1993

   M.Sc. in Computer Engineering, _____ KFUPM, 1998

   Ph.D. in Computer Engineering, _____ Texas A&M, 2004

4. Number of years of service at KFUPM: 16 years

   Original appointment: 1993, Graduate Assistant

   Dates of advancement in: 1998, Lecturer

   Rank : 2004, Assistant Professor

13. Other related experiences – teaching, industrial etc.

    None

14. Consulting, patents etc.

    None

15. State(s) in which registered

    None

16. Principal publications in last five years

    1. Syed M.S. Islam, M. Al-Mouhamed, S.M. Buhari, and Talal Al-Kharoubi, "A Hierarchical Design Scheme for Application of Augmented Reality in a Telerobotic Stereo-Vision System", the Saudi 18th National Computer Conference (NCC18), March 26-29, 2006. Riyadh, KSA.
    2. Syed M.S. Islam, Mayez A. Al-Mouhamed, Talal Al-Kharoubi, Seyed M. Buhari, "Augmentation of a Telerobotic Stereo-Vision System Using Graphical Overlays", First International Conference on Industrial and Information Systems [ICIIS 2006], Srilanka, 8 – 11 August, 2006.

17. Scientific and professional societies of which a member

    IEEE, IEEE-computer society, and IEEE Industrial Application

18. Honors and awards.

    3. Best Student in computer field in Saudi Arabia, KACST 1992
    4. High honor, KFUPM 1993
    5. Best Graduate Assistant, KFUPM 1998
    6. Distinguished service award, CCSE-KFUPM, 2006

19. Institutional and professional service in the last five years

    Chairman of technical committee for the 1st eServices symposium

    Chairman of technical committee for the 2nd eServices symposium

13. Percentage of time available for research or scholarly activity; 30%

    Percentage of time committed to the program; 70%

Curriculum Vitae

1. Name : Tarek Rahil Shelatmi
2. Rank : Assistant Professor, Computer Engineering Department
3. Degrees with fields, institution, and date
   B.Sc. in Electrical Engineering, University of Garyounis, Libya, June 1990
   M.Sc. in Electrical Engineering, University of Garyounis, June 1996
   Ph.D. in Electrical and Computer Engineering, Queens University, May 2003
4. Number of years of service at KFUPM: 5 years
   Original appointment: September, 2004, Assistant Professor
5. Other related experiences – teaching, industrial etc.

June 2002-Aug. 2004 GamaEng Inc, Ottawa, Canada, *Consultant on Wireless Networks*
May 2003- August 2004 University of Ottawa SITE, Ottawa, Canada
Research Associate and Adjunct Professor
January 2000 – April 2003 Computer Networks Laboratory, Queen's University
Research Assistant
September 1998 – December 1999 SDE , University of Waterloo
Research Assistant
September 96 – May 1998 University of Garyounis, Benghazi, Libya
Lecturer
August 94 – May 1998 JOEEF Oil Corporation, Benghazi Libya
Head of Telecommunication Department
February 91 – July 1994 JOEEF Oil Corporation, Benghazi Libya
Project Engineer in Telecommunication Department

6. Consulting, patents etc.

P1. T. Sheltami, "Voice over IP using the Warning Energy Aware Clusterhead Routing Protocol," filed by KFUPM May 2005, Pending
P2. T. Sheltami, "Wireless Monitoring System: SMS and IP based," filed by KFUPM July 2005, Pending
P3. T. Sheltami, "Smart Shopping Cart and Value Added Services using RFID," filed by KFUPM July 2005, Pending

7. State(s) in which registered: None

8. Principal publications in last five years

   1. Md. Golam Kaosar and Tarek R.. Sheltami, "Voice Transmission over Ad-Hoc Network: An Optimum Approaches to Maximize the Performance," Computer Communications, Volume 32, Issue 4, 4 March 2009, Pages 634-639.
   2. T. Sheltami "An Efficient Neighbor-Aware Protocol for SNET Formation," Journal of Interconnection Networks (JOIN) Vol. 9, No. 4 (2008) 439–454
   3. Tarek Sheltami, "Performance Evaluation of H.264 Protocol in Ad hoc Networks," Journal of Mobile Multimedia, Vol. 4, No.1 2008, pp. 59-70.
   4. T. Sheltami, Ashraf Mahmoud and Marwan AbuAmara, "An Ad hoc Wireless Sensor Network for Telemedicine Applications," The Arabian Journal for Science and Engineering Vol. 32, No.1B, April 2007, pp. 131-143.

5. Tarek R. Sheltami and Md. Golam Kaosar, "Improved Caching Mechanism for Ad hoc Network Routing Protocol," PCTE Journal of Computer Sciences Vol. 2, Issue No. 2, July 2006, pp. 48-53.
6. Tarek Sheltami, "Gateway Selection Review in Ad hoc Networks," The Journal of Computers, Vol.1, No.2, May 2006, pp. 8-14.
7. Tarek Sheltami, Ashraf Mahmoud, Marwan Abu-Amara, "Telecare Monitoring System Based on Wireless Sensor Network," The International Journal of Computer Science and Network Security, IJCSNS, Vol. 5 No. 12, December 2005, pp. 66-74.
8. T. R. Sheltami and H. T. Mouftah, "Average waiting time of Clusterhead Controlled Token for Virtual Base Station On-demand in MANETs," ACM 'Ad Hoc Networks' of the journal 'Cluster Computing', 2005, Vol. 8, pp. 157-165.
9. Elhadi M. Shakshuki, Tarek R. Sheltami, Nan Kang, and Xinyu Xing, "Tracking Anonymous Sinks in Wireless Sensor Networks," to appear The IEEE 23nd International Conference on Advanced Information Networking and Applications (AINA-09), Bradford, UK, May 26-29, 2009.
10. Elhadi M. Shakshuki, Haroon Malik, and Tarek R. Sheltami, "Lessons Learned: Simulation Vs WSN Deployment," to appear The IEEE 23nd International Conference on Advanced Information Networking and Applications (AINA-09), Bradford, UK, May 26-29, 2009.

Scientific and professional societies of which a member

1. The Saudi Scientific Society of Electrical Engineering (SSSEE) 2004.
2. The Institute of Electrical and Electronics Engineers (IEEE): IEEE Communications Society and IEEE Computer Society, 2000.
3. The Society of Electrical Engineers of Libya, 1990.

- Honors and awards.: None
- Institutional and professional service in the last five years

TPC in the following: IEEE Globecom 2003, Dallas Texas, November 29 - December 3, 2004, IEEE CCNC 2004, Las Vegas, Nevada USA, January 5-8, 2004, IEEE EWCN 2004, Phoenix, Arizona, USA, 14-17 April 2004, 22nd Biennial Symposium on Communications, June 1–3, 2004 Queen's University, Kingston, ON, Canada, IEEE ICC 2005, Seoul Korea, 16-20 May 2005, IEEE ISCC 2005, La Manga del Mar Menor, Cartagena, Spain June 27- 30, 2005, IEEE ICC 2006 Istanbul , Turkey 11-15 June, 2006, IEEE GLOBECOM 2006, San Francisco, California, USA. Nov 27th-Dec 1st, 2006, IEEE ICC 2007 Glasgow, Scotland, June24-28, 2007

5. Percentage of time available for research or scholarly activity; 35%
   Percentage of time committed to the program; 65%

1. Name : Uthman Abdulrahman Baroudi
2. Rank : Assistant Professor, Computer Engineering Department
3. Degrees with fields, institution, and date
   B.Sc. in Electrical Engineering from KFUPM, June 1988

   Msc. in Electrical Engineering from KFUPM, June 1990

   Ph.D. in Electrical Engineering, Concordia University, October 2000

4. Number of years of service at KFUPM: 13 years

   Original appointment: September, 1990, Lecturer

   Dates of advancement in: January, 2002, Assistant Professor

   rank :

5. Other related experiences – teaching, industrial etc.
   - Network Designer Sep. 2000 – Dec. 2001 Nortel Networks, Ottawa, Canada
   - System Designer March 2000 – Aug. 2000 SR Telecom, Montreal, Canada
6. Consulting, patents etc.
   - Method of radio resource management for integrated voice and data CDMA networks (pending US patent)
7. State(s) in which registered
   None

8. Principal publications in last five years

   1. S. Al-Qahtani and U. Baroudi, “Dynamically Prioritized Call Admission Control for RAN-Based Multi-Operators 3G/4G Cellular Wireless Networks”, submitted to Computer Communications Journal.

   2. U. Baroudi and Mohammad Mohuddin, "Performance Analysis of Internet Applications over an Adaptive IEEE 802.11 MAC Architecture" the Special Conference Issue of J Franklin Institute, 2006.

   3. U. Baroudi and A. Elhakeem, “A Simulation Study for Adaptive Admission /Congestion Control Policies for CDMA Based Wireless Internet” in Wireless Communications and Mobile Computing (WCMC) Journal, online edition May 2005.

   4. U. Baroudi, “EQOSA: Energy and QoS Aware MAC for Wireless Sensor Networks,” submitted to the 20th International Symposium on Signal Processing and its Applications (ISSPA 2007).

   5. U. Baroudi, Y. Mohammed and A. Mahmoud, “On the Performance of Downlink Power-Based Scheduling for Slotted CDMA Networks,” 64th IEEE-VTC 2006, Montreal, Canada.

   6. Yaser Al-Jarbou and U. Baroudi, “Performance of Heterogeneous Traffic in Roaming Based Sharing Multi Operator 4G WCDMA,” the 2nd International Symposium on Wireless Communication Systems 2005 (ISWCS'05), Siena, Italy.

   7. Salman Al-Qahtani and U. Baroudi, “An Uplink Performance Evaluation for Roaming-Based Multi-Operator WCDMA Cellular Networks,” The 4th

ACS/IEEE International Conference on Computer Systems and Applications, Sharjah, UAE.

8. Adel AlAkeel, Ashraf Mahmoud, and U. Baroudi, "On Optimizing Backoff Procedure to Enhance Throughput and Fairness for Wireless LANs", *IEEE 2nd ICTTA*, April 24 - 28, 2006, Damascus, Syria.

9. U. Baroudi, Yousuf Mohammed, and Ashraf Mahmoud "Adaptive QoS-Based Scheduler for 4G CDMA Wireless Networks", *IEEE 2nd CITTA* April 24 - 28, 2006, Damascus, Syria.

10. U. Baroudi, Yousuf Mohammed and Ashraf Mahmoud, "On the Performance of Slotted CDMA Networks," submitted to IEEE-VTC 2006.

11. U. Baroudi and A. Elhakeem, Adaptive Admission/Congestion Control Policy for Hybrid TDMA/MC-CDMA Integrated Networks with Guaranteed QoS, IEEE ICECS'03, Sharjah, UAE, December 14-17, 2003, pp. 1014-1017.

9. Scientific and professional societies of which a member
    1. Fellow, Syrian Engineering Society
10. Honors and awards.
    - FCAR Postgraduate Scholarship (1998)
    - Concordia University Fellowship (1996 – 1998)
11. Institutional and professional service in the last five years

    Referee for following scientific journals

    1. Journal of Computer Communications a Special issue on "Internet Monitoring and Measurement"
    2. ACM Mobile Networking and Applications (MONET) Special Issue on "Integration of Heterogeneous Wireless Technologies"
    3. Wiley WCMC journal's Special Issue on "Radio Resource Management for Wireless Internet"

    Referee for following scientific conferences

    INFOCOM 2006, IEEE VTC 2006, IEEE ICC 2005, 2007, IEEE GLOBECOM 2003, 2004

    Professional development activities in the last five years.

    1. Laboratory development for COE 445 (Internet Information Services) Laboratory development for COE 344 (old name: COE 442) (Computer Networks).

12. Percentage of time available for research or scholarly activity; 50%
    Percentage of time committed to the program; 50%

Curriculum Vitae

1. Name: Zubair Ahmed Baig
2. Rank : Assistant Professor, Computer Engineering Department
3. Degrees with fields, institution, and date
   B.Sc. in Computer Engineering, KFUPM, January 2002.

   M.Sc. in Electrical & Computer Engineering, University of Maryland, December 2003.

   Ph.D. in Computer Science, Monash University, Sept. 2008.

4. Number of years of service at KFUPM: 1 year
   Original appointment: 2008, Assistant Professor

5. Other related experiences – teaching, industrial etc.

Teaching experience at KFUPM:

COE 202: Fundamentals of Computer Engineering, -COE 203: Digital Logic Laboratory

Lecturer/Tutor March 2005 – July 2008 Monash University, Melbourne Australia.

Teaching assistant January 2002 – December 2003 University of Maryland, College Park, USA.

Information Security Specialist, September 2007 – September 2008 Fraud Management Technologies Ltd., Melbourne Australia

6. Consulting, patents etc: None
7. State(s) in which registered: None
8. Principal publications in last five years:

i. Zubair A. Baig and A. I. Khan. "DDoS Attack Modeling and Detection in Wireless Sensor Networks," *Mobile Intelligence: Mobile Computing and Computational Intelligence*, John Wiley & Sons, April 2008.

ii. Zubair A. Baig and A. I. Khan. "A Fault-Tolerant Mechanism for Detecting DDoS Attacks in Cluster-Based Wireless Sensor Networks," *Sensor and AdHoc Networks: Theoretical and Algorithmic Aspects, Lecture Notes in Electrical Engineering*, Vol. 7, April 2008.

iii. Salman A. Khan and Zubair A. Baig, "A Simulated Evolution-Tabu Search Hybrid Metaheuristic for Routing in Computer Networks," *In Proceedings of the IEEE Conference on Evolutionary Computation (CEC)*, Singapore, September, 2007.

iv. Zubair A. Baig, M. Baqer, and A. I. Khan. "SGSIA – In-Network Data Pre-Processing for Secure Grid-Sensor Integration," *In Proceedings of the 2nd IEEE Intl' Conference on eScience and Grid Computing*, Amsterdam, The Netherlands, December, 2006.

v. Zubair A. Baig, M. Baqer, and A. I. Khan. "A Pattern Recognition Scheme for Detecting Distributed Denial of Service (DDoS) Attacks in Wireless Sensor Networks," *In Proceedings of the IEEE International Conference on Pattern Recognition*, Hong Kong, China, August, 2006.

vi. M. Baqer, A. I. Khan, Zubair A. Baig, "Implementing a Graph Neuron Array for Pattern Recognition within Unstructured Wireless Sensor Networks," *2nd International Symposium on Ubiquitous Intelligence and Smart Worlds, 6-7 December 2005, Nagasaki Japan, Springer-Verlag, Lecture Notes in Computer Science*, Vol. 3823, pp. 208-217.

vii. Zubair A. Baig, "Preventing Service Flooding on Internet DNS Servers thru an Application-Level Mechanism-A Performance Analysis," *International Conference on Security and Management*, Las Vegas, USA, June, 2005.

viii. Mostafa Abd-El-Barr, Salman A. Khan, Zubair A. Baig, "Performance Analysis of a Hybrid Scheme for Tolerating Mobile Support Station Failures," *International Conference on Wireless Networks*, Las Vegas, USA, June, 2002.

ix. Zubair A. Baig, "Securing the High Performance Grid Computing to Sensor Network Integration Channel," *DART Technical Report*, Monash University, March, 2007.

9. Scientific and professional societies of which a member

1. IEEE
2. Australian Computer Society
3. Security Research Group, KFUPM.

10. Honors and awards.

1. Awarded best student award by IEEE-AEC in 2002 for exceptional performance in the B.Sc. program
2. Awarded highest honors by HE the Rector of KFUPM for undergraduate academic performance

11. Institutional and professional service in the last five years

- Delivered a seminar on: Distributed Denial of Service Attacks and Countermeasures in March 2009 at KFUPM

12. Institutional Professional development activities in the last five years.

Attended the following specialized development workshops:

1. Measuring Research Performance, March, 2009, KFUPM
2. KAUST-KFUPM collaboration avenues, March, 2009, KFUPM
3. Workshop on Sequence Design and Its Applications in Communications and Cryptography 4-6 December 2008, Melbourne, Australia
4. 4th TERENA NRENs and Grids Workshop, 6-7 December, 2006, Amsterdam, The Netherlands

Attended the following conferences:

a. Second Saudi Engineering Conference, March, 2009
b. IEEE eScience and Grid Computing Conference, December, 2006, Amsterdam, The Netherlands
c. IEEE International Conference on Pattern Recognition, August 2006, Hong Kong, China
d. International Conference on Security and Management, June 2005, Las Vegas, USA

5. Percentage of time available for research or scholarly activity; 50%
   Percentage of time committed to the program; 50%

Curriculum Vitae

1. Name : Muhammad Wasim Raad
2. Rank : Lecturer , Computer Engineering Department
3. Degrees with fields, institution, and date

B.Sc. in Electrical Engineering, _____KFUPM_____ , 1981
M.Sc. in Electrical Engineering, _____KFUPM, 1985
Ph.D. in Electrical & Electronic Engineering, ____University of Bradford, UK , July 2005

4. Number of years of service at KFUPM: 23 years
   Original appointment: May, 1986, Lecturer

5. Other related experiences – teaching, industrial etc.
   I taught microcontroller and digital system design courses and the labs and upgraded them to comply with IEEE & ABET international requirements. I have introduced lecture notes and engineering design content to senior design course. I authored lab manual for digital system design lab as well as for microprocessor based systems lab. I won the best project supervision and the best services award. I was involved in the smart card project for the KFUPM campus (2003-2005). I got distinguished evaluation in teaching and research all throughout my period of service. I am involved right now in a funded King Abdulaziz City for Science and Technology project titled' A Smart Card Management System. I was invited to give talks in a number of regional and international conferences.
   I Got approval lately for the two following innovation projects under preparation for being commercialized: 'Design of a mobile patient medical alert system' and 'Design of a Smart System for Safeguarding children from hazardous appliances in the Kitchen'.

6. Consulting, patents etc: None

7. State(s) in which registered: None

8. Principal publications in last five years

M.W. Raad & L. Cheded, 'Novel Peak detection Algorithms for Pile-up Minimization in Gamma Ray spectroscopy', 2006 IEEE Instrumentation And measurement Technology Conference, Sorrento, Italy, 24-27 April 2006.

M.W.Raad, A Smart Card Based Identification and E-payment System, in the Smart Card Conference, Bahrain Information Technology Society (BITS),Bahrain, Jan. 2005.

M. W. Raad and M. Mohandes, A Smart Card Based Driving License System, 2nd IEEE GCC 2004 conference 'Advancing Technology in the GCC: Challenges and Solutions', Bahrain, 23-25 November 2004.

M.W. Raad, J.M. Noras, M. Shafiq and A. Aksoy, 'Gamma-Ray Peak Detection Algorithms Using Embedded DSP', ESS Conference, October 2004, UK.

M.W. Raad, J.M. Noras and M. Deriche, 'Parameter Estimation and Digital Peak Localization Algorithms For Gamma Ray Spectroscopy', In the proceedings of the fourth International Symposium on Communication systems, Networks and Digital Signal Processing, University of Newcastle, UK,20-22 July 2004.

J.M. Noras, M.W. Raad and M. Deriche, 'Pileup free parameter estimation and digital online peak localization algorithms for Gamma Ray Spectroscopy', 10th Annual IEEE technical exchange meeting, March 23-24, 2003, KFUPM, Dhahran, Saudi Arabia.

9. Scientific and professional societies of which a member
IEE member since 1998.
Saudi Computer Society member since 2000.

10. Honors and awards.
I won the best project supervision and the best services award.

I got distinguished evaluation in teaching and research all throughout my period of service.

11. Institutional and professional service in the last five years
As a member of CCSE Publicity & Information Committee, in addition to Departmental Information & Library Committee I coordinated visits to department and college, coordinated department open day and exhibitions, student-faculty meetings, and publicized student projects in exhibitions held throughout the kingdom. I reviewed and edited departmental brochures, in addition to CCSE part of the KFUPM booklet, Submitted the information committee part of the tactical COE plan, coordinated the yearly program of awareness for orientation students, prepared statistics reports on department, coordinated career day of COE department, worked with students on project competition contests, upgraded COE 400 Digital System Design Lab, prepared Purchase orders for labs, taught in girls college Dammam. Contributed in upgrading the syllabus of COE400 and COE205 courses according to ACM requirements as a member in Ad-hoc committees. Prepared the COE labs according to ABET requirements.

Professional development activities in the last five years: I helped students to improve their presentation skills. I had coordinated students/faculty get together meetings. I edited departmental graduate and undergraduate brochures, in addition to coordinating departmental open day and career day on a yearly basis.
I offered consultation to industry on a part-time basis in smart card technology.
I participated in ad-hoc committees to review COE curriculum and safety issues in labs.
I was one of the few people who participated in establishing the curriculum for COE department. I was actively involved in student computer club activities and social parties.

12. Percentage of time available for research or scholarly activity; 20%
Percentage of time committed to the program; 80%

Curriculum Vitae

1. Name : Bambang Ali Basyah Sarif
2. Rank : Lecturer, Computer Engineering Department
3. Degrees with fields, institution, and date

   B.Sc. in Electrical Engineering, Bandung Institute of Technology, Indoensia, February 2000.

   M.Sc. in Computer Engineering, KFUPM, August 2003.

4. Number of years of service at KFUPM: 8 years
   Original appointment: 2001, Research Assistant

   Dates of advancement in rank: 2004, Lecturer

5. Other related experiences – teaching, industrial etc.
   - COE 202: Fundamentals of Computer Engineering Laboratory
   - Co-supervisor for student projects in Internet Information Services course (COE 445)
   - Taught shortcourses: UNIX system administration, PHP, Matlab, PERL and web development
   - UNIX system administration, HTML and javascript, web application with PHP and MYSQL, database design and implementation, UNIX shell scripting, C and java programming languages, Assembly and VHDL.
6. Consulting, patents etc: None
7. State(s) in which registered: None

8. Principal publications in last five years:
   1. Sarif, Bambang A.B.; Abd-El-Barr, Mostafa; "*The Use of Multiple Connected Pseudo Minterms in the Synthesis of MVL Functions"*, Submitted, 39th International Symposium on Multiple-Valued Logic, 2009. ISMVL 2009.
   2. Sarif, Bambang A.B.; Abd-El-Barr, Mostafa; "*Synthesis of MVL Functions Using Discrete Particle Swarm Optimization*", 2008 IEEE Swarm Intelligence Symposium.
   3. Sarif, Bambang A.B.; Abd-El-Barr, Mostafa; "*Fuzzy-based Direct Cover Algorithm for synthesis of Multi-Valued Logic Functions*", 2008 The IASTED International Conference on Circuits and Systems.
   4. Sarif, Bambang A.B.; Abd-El-Barr, Mostafa; "*Minterm Injection Technique for Synthesis of Multiple Valued Logic Functions*", 2008 the IASTED International Conference on Circuits and Systems.
   5. Abd-El-Barr, Mostafa; Sarif, Bambang A.B.; "*Weighted and Ordered Direct Cover Algorithms for Minimization of MVL Functions"*. 37th International Symposium on Multiple-Valued Logic, 2007. ISMVL 2007. May 2007. Page(s):48 - 48 (cited 3 times)
   6. Sarif, Bambang A. B.; Abd-El-Barr, Mostafa; "*Synthesis of MVL Functions - Part I: The Genetic Algorithm Approach"*. International Conference on Microelectronics, 2006. ICM '06. 16-19 Dec. 2006. Page(s):154 - 157 (cited 4 times)
   7. Abd-El-Barr, Mostafa; Sarif, Bambang A. B.; "*Synthesis of MVL Functions - Part II: The Ant Colony Optimization Approach"*.

International Conference on Microelectronics, 2006. ICM '06. 16-19 Dec. 2006. Page(s):158 - 161 (cited 4 times)

8. Sarif, B.A.B.; Abd-El-Barr, M.; Sait, S.M.; Al-Saiari, U.; *"Fuzzified ant colony optimization algorithm for efficient combinational circuits synthesis"*. Congress on Evolutionary Computation, 2004. CEC 2004. Volume 2, 19-23 June 2004. Page(s):1317 - 1324 (cited 4 times)

9. Scientific and professional societies of which a member: None

10. Honors and awards.
    3. Award of Merit for Excellence in Academic Performance, KFUPM (2003)
    4. Studentship from the Ministry of Information, Indonesia (1993-1995)

11. Institutional and professional service in the last five years
    Delivered shortcourses:

    - UNIX system administration (2004)
    - Web development using PHP (2004)

    Active members of different committees in departmental and college level in KFUPM.
    Active member of Open Access Initiative for COE department
    Web

12. Percentage of time available for research or scholarly activity; 20%
    Percentage of time committed to the program; 80%

Curriculum Vitae

1. Name : Hakim Adiche
2. Rank : Lecturer, Computer Engineering Department
3. Degrees with fields, institution, and date
   B.Sc. in Computer Engineering, National Institute of Electricity and Electronics, Algeria, June 1993

   M.Sc. in Computer Engineering, King Fahd University of Petroleum and Minerals, Saudi Arabia, October 1997
4. Number of years of service at KFUPM: 11 years

   Original appointment: March, 1998, Lecturer
5. Other related experiences – teaching, industrial etc.
   Teaching computer networks laboratory COE 344

   Teaching preparatory computer science PYP002

   Teaching Cisco networking courses for CCNA level.

   Taught network management laboratory COE 444

   Taught digital circuits laboratory COE 202

   Developed laboratory experiment for the computer networks laboratory.

   Developed laboratory experiment for the network management laboratory.

   Developed laboratory experiments for the Multimedia course COE 445
6. Consulting, patents etc.
   Consultant for one month for Sci-Tech-Khobar, on the issue of Audio/Video traffic.

   Consultant for one month for ITC, KFUPM on the issue of structured cabling.
7. State(s) in which registered
   none
8. Principal publications in last five years
   H.Adiche, *Analytic Modeling of Mpeg-4 and H.263 Encoded Video Traces*, Accepted for presentation at the ACS/IEEE International Conference on Computer Systems and Applications, 2003.
9. Scientific and professional societies of which a member: None
10. Honors and awards: None
11. Institutional and professional service in the last five years
    Design and implementation of a computer network laboratory system.

    Developed activities for Cisco regional academy hosted in KFUPM

    Trained students and instructors on Cisco networking technology.

    Developed activities for the computer networks laboratory.

    Issued several purchase requests for networking equipment to be used in the computer networks laboratory.

Professional development activities in the last five years.

- Attended Cisco training for the CCNA level and obtained the certifications for the purpose of academy teaching
- Obtained the Cisco certified Academy Instructor certificate
- Obtained the Cisco CCNA industrial certificate
- Certified Internet Professional BCIP Web Administrator
- Certified Information Security Administrator
- Certified Network Support Specialist
- Certified Unix System Administrator
- Certified Linux System Administrator
- Certified Network Administrator
- Certified Telecommunication Specialist

12. Percentage of time available for research or scholarly activity; 20%
Percentage of time committed to the program; 70%

Curriculum Vitae

1. Name : Hazem Helmi Selmi
2. Rank : Lecturer, Computer Engineering Department
3. Degrees with fields, institution, and date

   B.Sc. in Electrical Engineering, KFUPM, August 1991

   M.Sc. in Electrical Engineering, KFUPM, May 2000

4. Number of years of service at KFUPM: 9 years

   Original appointment: May, 2001, Lecturer

5. Other related experiences – teaching, industrial etc.
   1992-1999 Electronic Engineer an IT supervisor in various Saudi Companies.

6. Consulting, patents:
   None

7. State(s) in which registered
   None

8. Principal publications in last five years
   None

9. Scientific and professional societies of which a member
   Jordanian Engineers Associations

10. Honors and awards.
    Special Achievement Award (CCSE), 2003-034

11. Institutional and professional service in the last five years: None
    Professional development activities in the last five years.
    - Attended Cisco training for the CCNA level and obtained the certifications for the purpose of academy teaching
    - Obtained the Cisco certified Academy Instructor certificate
    - Obtained the Cisco CCNA industrial certificate
    - Certified Internet Professional BCIP Web Administrator
    - Certified Information Security Administrator
    - Certified Network Support Specialist
    - Certified Unix System Administrator
    - Certified Linux System Administrator
    - Certified Network Administrator
    - Certified Telecommunication Specialist

    Professional development activities in the last five years.

    1. Attended a workshop on “How to be an Effective University Teacher”, DAD, ,KFUPM 7-8 Sept. 2002;
    2. Workshop on “Critical Thinking”, KFUPM, 7-10 September 2003;
    3. Workshop on “Publishing Content and Quizzes in WebCT”,DAD, KFUPM, 2004;
    4. Workshop on Effective use of Collaborative Learning in the Class Room, DAD,KFUPM, Sept.20, 2006;

12. Percentage of time available for research or scholarly activity; 20%

Percentage of time committed to the program; 70%

Curriculum Vitae

1. Name: Kamal Chenaoua
2. Rank : Lecturer, Computer Engineering Department
3. Degrees with fields, institution, and date

   B.Sc. in Electrical Engineering, National Polytechnic of Algiers (Algeria), 1986

   M.Sc. in Electrical Engineering, University of Hull in UK, 1989

4. Number of years of service at KFUPM: 10 years

   Original appointment: September, 1998, Lecturer

5. Other related experiences – teaching, industrial etc.

6. Consulting, patents:
   None

7. State(s) in which registered
   None

9. Principal publications in last five years

1. B. Al-Saihati, H. Al-Darwiesh, K. S. Chenaoua "Use of ECC and Watermarking for Image integrity and Correction", BTM-2004, Saudi Arabia, May 2004
2. R. Kayal, K. S. Chenaoua "Video Compression Based on Segmentation and Frame Differencing", BTM-2004, Saudi Arabia, May 2004
3. K. S. Chenaoua, A. Bouridane, “PCA Based Choice of Representative Colors for Skin Detection”, Turkey, Sep. 2005,EUSIPCO-2005
4. K. S. Chenaoua, A. Bouridane, “A New Approach in the Choice of a Color Space for Skin Detection”, IMVIP 2005-Belfast UK.
5. K. S. Chenaoua, A. Bouridane, “Skin Detection Using a Markov Random Field and a New Color Space”, Italy, Sep. 2006, EUSIPCO-2006
6. K. S. Chenaoua, A. Bouridane, "A PFA Based Skin Detection Algorithm using a Markov Random Field". USA, Oct. 2006, ICIP06
7. K. S. Chenaoua, A. Bouridane, " A Mean Shift and Non-Negative PCA Based Color Image Segmentation Approach”, ICIP 2009-Cairo Egypt.

10. Scientific and professional societies of which a member

11. Institutional and professional service in the last five years: None
    Professional development activities in the last five years.

    5. CCSE Innovation project: “TV Watching Distance Safety Monitor”, 2005
    6. University Funded Project: “Detection of Sandstorms and Dust using Wireless Sensor Networks and RFID Technology”
    7. University Funded Project: “Color Iris Recognition”
    8. University Funded Project: “A Swarm of Robots for In-Building Rescue Operations”

9. Attended the IBTIKAR 2008 exhibition in Riyadh, as student supervisor and project advisor for the project: “Frustrated Total Internal Reflection Based Touch Surface for use a Touch Screen”, IBTIKAR-2008, Riyadh

12. Percentage of time available for research or scholarly activity; 20%

    Percentage of time committed to the program; 70%

Curriculum Vitae

1. Name : Masud-ul-Hassan
2. Rank : Lecturer, Computer Engineering Department
3. Degrees with fields, institution, and date

   B.E. in Electronics Engineering, NED University, Pakistan, January 1988
   M.S. in Computer Engineering, KFUPM, Dhahran, July 1993
4. Number of years of service at KFUPM: 20 years

   Original appointment: September, 1993, Lecturer

   Dates of advancement in rank: None

5. Other related experiences – teaching, industrial etc.
   1. January 1989 to December 1989 - Worked as an Electronic Design Engineer, Pakistan Steel Mills, Karachi, Pakistan.

   2. January 1990 to August 1993 - Worked as a Research Assistant in Computer Engineering Department, KFUPM, Dhahran, Saudi Arabia.

6. Consulting, patents etc.
   List as appropriate

7. State(s) in which registered
   None

8. Principal publications in last five years
   None

9. Scientific and professional societies of which a member
   - Member - Pakistan Engineering Council.
   - Member - Saudi Council of Engineers

10. Honors and awards.
    Best Teaching Award (CCSE), 2005-06

11. Institutional and professional service in the last five years
    Professional development activities in the last five years.
    Attended seminars/workshops arranged by Deanship of Academic Development, KFUPM.

12. Percentage of time available for research or scholarly activity; 20%

    Percentage of time committed to the program; 70%

Curriculum Vitae

1. Name: Ya'u Garba Isa
2. Rank: Lecturer, Computer Engineering Department and Windows System Administrator, College of Computer Sciences and Engineering
3. Degrees with fields, institution, and date

B.Eng. in Electrical Engineering, ATBU, Bauchi Nigeria, September 1998.

M.Sc. in Computer Engineering, KFUPM, June 2003.

4. Number of years of service at KFUPM: 8 years

Original appointment: 2001, Research Assistant

Dates of advancement in rank: 2004, Lecturer

5. Other related experiences – teaching, industrial etc.

Windows network system and security administration, Microsoft SQL database design, implementation and administration. Software design and development, programming in C/C++, C# and scripting with Perl and Vbscript

Embedded system design – PIC microcontrollers, digital electronics, DSP and image processing for machine vision. Experienced in circuit board design (layout and fabrication).

Taught fundamental of computer engineering labs, short-courses in linux OS, computer security and web design.

6. Consulting, patents etc: None
7. State(s) in which registered: None

8. Principal publications in last five years: None

9. Scientific and professional societies of which a member: None

10. Institutional and professional service in the last five years

Delivered short-courses in:

- Web design with FrontPage, 2005.
- Introduction to Linux operating system, 2004.
- Computer security, 2004.

11. Institutional Professional development activities in the last five years.

Attended several specialized development workshops, such as:

1. Course on Microsoft SQL server programming and administration, 2008.
2. E-learning workshop on Flash design, 2005
3. Introduction to Oracle Programming, 2004
4. Course on Windows Active Directory, 2003.

12. Percentage of time available for research or scholarly activity; 20%

Percentage of time committed to the program; 70%

Appendix C

LABORATORY EQUIPMENT

The following tables provide a list of major instructional and laboratory equipment.

Digital Logic Design Lab

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)	Utilization*
PC	Dell 933 Dimension	18	75%
ISE 7.1i Webpack software**	Xilinx	14	75%
Printer	HP LaserJet 4210	1	100%
Modelsim XE 6.0**	Mentor Graphics	14	75%
EEPROM Programmer	Dataman Pro	3	13%
Spartan-3 Boards	Digilent	14	75%
Prototyping Boards	Fluent	9	25%

** relative to total number of experiments conducted*

*** software tool*

Microprocessor Lab

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)	Utilization*
PC	Hp compaq	12	80%
Digital trainer	E&R Instruments	12	65%
Oscilloscope	FLUKE/PM3092	7	70%
Logic analyzer	Thurlby/ LA 3200	6	40%
EPROM eraser	Stag/SE 15	1	15%
EPROM programmer	Chip Master 6000	1	20%
IC tester	RS	1	15%
Function generator	Various	2	10%
Logic probes	Various	12	60%
Chip Master Software (for EPROM programming)**	Chip Master 6000	1	20%
Assembler/Debugger**	Microsoft	12	35%

** relative to total number of experiments conducted*

*** software tool*

Network & Communication Lab

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)	Utilization*
PC	IBM	26	100%
Routers	Cisco	12	40%
Switches	Cisco	8	100%
Switches	ExtermeNetworks	3	100%
Switches	3Com	3	100%
Switches	BayStack	3	100%
ATM Switches	ForeRunner	1	7%
Access-Point	Cisco	1	7%
Access-Point	D-Link	5	7%
Modems	US-Robotics	10	7%
Crimping Tools	RS	2	7%
Cable Testers	Fluke	2	7%
Cutters	RS	5	7%
Ethereal**	GNU License		47%
Windows 2000**	Microsoft		100%
Linux**	GNU License		100%
Packet Tracer**	Cisco		
Apache Web Server**			

** relative to total number of experiments conducted*

*** software tool*

Digital System Design Lab

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)	Utilization*
PC	Dell 933 Dimension	9	
Printer	HP LaserJet 1300	1	
Flash microcontroller programmer	Flash lab 51	10	90%
8051 IDE environment	Pinnacle 52	10	90%
Ethernet microcontroller development system	Tiny 80C400 board	12	10%
Ethernet to Wi-fi converter		2	
serial communication troubleshooting software**	Comdebug		10%
Labview 7**			10%
Oracle Database**			
Digital oscilloscope		11	
Variable power supplies		5	
Digital trainers		6	
Solder iron		1	

** relative to total number of experiments conducted*

*** software tool*

Printed Circuit Board Lab

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)
DRILLING AND ROUTING MACHINE	CNC-1000 / MAPE	1
PCB DRILLING MACHINE	606-664 / RS	1
HI SPEED DRILL MACHINE FOR PCB	- / Fortex	1
Power Supply	TPS2303DD / IsoTech	1
Solder/ Desolder Unit	Ex-750 / APE	2
Desolder Unit	SMD-500 / APE	2
Rework Station	850 D / Hako	1
Chemicals Tank for PCB manufacturing	PB720 / Mega	1
Copper Plating Tank	PL 904 / Mega	1
TIN / LEAD Plating Tank	PL 902 / Mega	1
Hot Air Drying Machine	BD 610 / Mega	1
Spray etch machine	TE-5P-MD / Mastertech	1
Tin Plating Machine	-	1
UV EXPOSURE UNIT FOR PCB	-	2
Deluxe Screen Printing Machine	- / HG Kippex	1
Drilling and Routing Machine	S62 / Protomat	1
PC / Win XP	Pent. 4 / HP	1
PC / Win XP	Pent. 4 / PC-Net	1
Printer	LaserJet 4 / HP	1
Scanner	UT24 / Plustek	1
Oven	DS2F/ GenLab	1
Dry film laminator	-	1
CAMERA FOR PCB WORK	RM-3600/ Agfa	1
UV EXPOSURE UNIT FOR PCB	2014 / RS	2
INSPECTION UNIT	Vista / PLESSEY	1
UV EXPOSURE UNIT	AY 218 / Mega	1
Eagle Software Version 4.1 for PCB schematic, layout and auto router**		

** relative to total number of experiments conducted*

*** software tool*

Robotics Lab

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)
PC	Clone	2
PUMA 560 Robot ARM	Unimation	2
SIX DOF ARMS	KFUPM	10
Cameras	Sony	2
VAL II OS and Robot Programming Language**	2014 / RS	
C# and C++ with Windows and Linux for programming robotic embedded systems**	Vista / PLESSEY	
DirectX-Direct 3D for graphical modeling and visualization**	AY 218 / Mega	
Distributed Component Client-Server Telerobotic System using .NET remoting**		

** relative to total number of experiments conducted*

*** software tool*

Senior Design Project Lab

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)
PC w/LCD Monitors / Win XP	Pent. 4 / DTK	2
PC w / Analog monitors / Win XP	Pent. 4 / IBM	3
Laptop PC / Win XP	Pent. 4 / HP	10
Work Station / Unix	Ultra 10 / SUN	1
Terminal	VT 320 / Digital	1
Logic Analyzer	1230 / Tektronik	1
Oscilloscope	300 MHz. / Tektronik	1
Logic Design Board	HP-1 / E& L Instrument	1
Windows XP**		
Unix**		
Mesh Networking Software**		

** relative to total number of experiments conducted*

*** software tool*

FPGA & Design Automation Lab

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)
SUN Workstation/Solaris 9.0	SuNBlade 150 / SUN	2
PC/Windows XP	Pent. 4 / Win XP	6
Printer	LaserJet 4 / HP	1
Labview Ver. 7.1 & 8	National Instruments	1 (License for dept. use) + 4
Mentor Graphics	Mentor	3 Different Packages (25 Licenses)
Xilinx Ver ISE 8	Xilinx	1 package (educational license)
Synopsis (under Unix)	-	1
Data Acquisition Test unit	Elvis / National Instruments	2
FPGA & Realtime Controller unit	Compact Rio / National Instruments	1
GPIB Data Acquisition unit	GPIB / National Instruments	1
Vertex 4 Evaluation Development Board	ML402 / Xilinx	1
General Response Instrumentation unit	National Instruments	1
Windows XP**		
Lab view Version 7.1 & 8**		
Mentor Graphics**		
Xilinx Version ISE 8**		
Synopsis**		

** relative to total number of experiments conducted*

*** software tool*

Performance Engineering Lab

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)
PC / Win XP	Pentium 4 / PC-Net	8
PC / Win XP	Pentium 4 / HP Compaq	3
Switch	4000 / Cisco	1
Hub 24 Port	3300TM / 3 Com	1
Hub	Catalyst 3550 / Cisco	1
Myrinet Switch 16 Port	M3-E16 / Myricom	1
Hub	1000Tx / 3 Com	1

Graduate Research Lab

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)
PC/Win XP	Pentium 4 / PC-Net	2
PC/Win XP	Pentium 4 / IBM	1
PC/Win XP	Pentium 4 / HP	1
Printer	LaserJet 4100TN / HP	1
Projector with Screen	Infocus	1
Scanner	ScanJet 3970/ HP	1

Unix/Linux Labs

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)
PC	HP Compaq	27
Linux OS	Mandrake10.1	Free License

The Unix/Linux computer servers are located in room 22/338 which contains the following major items.

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)
Workstation	Sunfire VT120	10
Workstation	Sunfire VT210	5
PC (linux cluster)	HP Compaq	20
Server (linux)	DELL PowerEdge 4400	1
Server (fileserver: unix home directory)	Sun Microsystem StorEDGE L20	1
Server (samba: ccse-fachome and ccse-home)	HP Compaq	2
Server (toolserver, for unix tools and applications)	Sun Ultra Enterprise 450	3
Solaris OS	Solaris 9	Free License
Linux OS	Mandrake 10.1	Free License
Linux OS	Fedora 4	Free License
Opnet	Opnet 12.0 / Opnet Technologies	29
Matlab	Matlab 7.0.1.24704 (R14) / The MathWorks	50
Mentor Graphics	2006 Release / Mentor Graphics	25
Synopsys	2006 Release / Synopsys	20
DFT-PRO	DFT-PRO Pro / Syntest	5
Magic (VLSI cad tools)	Magic-7.1.5	Free License
MPI (parallel computing tools)	mpich-1.2.6	Free License
PVM (parallel computing tools)	pvm-3.4.4	Free License
NS (network simulator)	NS-2.30	Free License

CCSE General-purpose Labs

***Lab Location:* 22/333**

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)
PC	HP Compaq DC7100	26
Printer	HP Laserjet 9050n	2

***Lab Location:* 22/335**

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)
PC	HP Compaq DC7100	35
Printer	HP Laserjet 9050n	1

***Lab Location:* 22/410**

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)
PC	HP Compaq DC7100	35
Printer	HP Laserjet 9050n	1

***Lab Location:* 22/416**

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)
PC	Compaq Evo	27
Printer	HP Laserjet 9000dn	1

***Lab Location:* 23/015**

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)
PC	Compaq Evo	27
Printer	HP Laserjet 2200d	1

***Lab Location:* 23/017**

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)
PC	IBM ThinkCenter	36
Printer	HP Laserjet 5siMX	1

***Lab Location:* 23/018**

Hardware/Software Item Name/Description	Model/Manufacturer	Quantity (Unit or License)
PC	HP Compaq DC7100	35
Printer	HP Laserjet 8150DN	1

All CCSE general-purpose labs have access to the following common computer applications.

Software Item Name/Description	Quantity (Unit or License)
CadSoft Eagle 4.1	5 (floating)
MATLAB 7.0	20 (floating)
Microsoft Office 2003	unlimited (bulk license)
Microsoft FrontPage 2003	unlimited (MSDNAA)
Microsoft Project 2003	unlimited (MSDNAA)
Jcreator (Java Editor)	Free license
Microsoft Visual Studio 2003	unlimited (MSDNAA)
Microsoft Visual Studio 2005	unlimited (MSDNAA)
Microsoft Visual Studio 6.0	unlimited (MSDNAA)
Microsoft SQL server clients	unlimited (MSDNAA)
Oracle server clients	Free license
Xilinx ISE 7.1i	Educational license (free)
Macromedia Flash	Single (floating)
Masm	Free license
Synchron Eyes 2.02	50

Appendix D. INSTITUTIONAL SUMMARY

This Appendix is separately submitted with this report.