COE ABET COMMITTEE

Activity Report

Term T131

COMPUTER ENGINEERING

Program

at

King Fahd University of Petroleum & Minerals
DHAHRAN, SAUDI ARABIA

11 February 2014

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Summary

This report presents the activities of the ABET Committee for the BS program at the Computer Engineering Department during semester 131. Activities included mapping student outcome assessments to courses for the new curriculum. A new student outcome assessment plan was also developed for the new 2-year assessment cycle extending from semester 131 to semester 142. The report reviews the corrective actions adopted by the COE Council early in semester and reports on progress on their implementation. Actions taken by the ABET Committee for improving learning and assessment in the COE program during the semester are outlined. These included efforts to improve on new labs, introducing guidelines and templates for the capstone senior project course, enhancing the visibility of the ABET process at the department, and improving ABET documentation, reporting and archiving. The report describes the assessment process carried out this semester on eight out of the twelve student outcomes adopted by the COE program. Assessment results are presented and discussed. Comparisons are made with the latest reported assessments for the same outcome. Comments and proposals for corrective actions are reported.

Introduction

Section 1 of the report gives a summary of the activities related to mapping student outcome assessments to courses for the new curriculum adopted starting semester 121 for the BS program at the COE Department. Section 2 describes the development of the new student outcome assessment plan for the new assessment cycle extending from semester 131 to semester 142. Section 3.1 reports on the corrective actions adopted by the COE Council in T131 based on assessments carried out in T122. Section 3.2 summarizes additional actions initiated by the ABET Committee during the report period for improving the learning and assessment processes and enhancing the ABET culture at the department. Section 4 presents the results of the direct assessment performed on eight outcomes in T131 as per the new assessment plan.

1. Mapping Student Outcome Assessments to Courses for the New Curriculum

In semester 121, the Computer Engineering department has introduced a new undergraduate program. The COE ABET Activity Report for T122 described the motivation for adopting the new curriculum and gave an account of its main features. Appendix 1 shows the new BS degree plans for both the summer training and the COOP training options. Appendix 2 shows the coverage of the student outcomes in the courses of the new curriculum.

Table 1 shows the new mapping developed this semester for the student outcome assessments to courses for the new curriculum. In this table, "X" indicates outcome coverage while "A" indicates outcome assessment. Assessments involve a total of eleven core courses. With the course pair COE 351/COE 399, the student takes only one of the two courses, depending on whether he selects the COOP or the summer training option of the program. Similarly for the depth elective course pair COE 405/COE 444 the student selects either courses for the Computer Systems and Computer Networks depth options, respectively. In developing this mapping, we adopted the following criteria:

i. Balanced assessment effort for sustainability: On average, a course is used to provide assessments for about 3 outcomes. The maximum number of outcomes per course is 8 (for the COE 485 Senior Project course). Moreover, each outcome is assessed based on 2-3 courses with the exception of outcome (g) which is based on the course pair COE 351/COE 399.

ii. Early assessment where possible: Some outcomes, e.g. outcomes (a) and (b), could be assessed earlier courses, and the student is expected to have achieved them early in the program. Therefore, will be assessed in 200/300-level courses.

iii. Close-to-graduation assessment of important outcomes: The plan assesses the most important computer engineering outcomes, e.g. (c) and (L), when students are closer to graduation, i.e., using high level courses.

Table 2 shows courses used for assessing each of the 12 student outcomes (a to L).

The mapping of student outcomes assessment to courses of the new COE Curriculum was discussed and approved at the COE Council meeting #7/1434-135H held on Monday October 28, 2013.

Table 1. Mapping of student outcomes assessment to courses of the new COE Curriculum. X: Outcome covered in the course, A: Outcome assessed in the course.

Course \ Outcome	(a) apply knowledge of mathematics, science, and engineering	(b) design and conduct experiments, analyze and interpret data	(c) design a system, component, or process to meet desired needs	(d) function on multi-disciplinary teams	(e) identify, formulate, and solve engineering problems	(f) understanding of professional and ethical responsibility	(g) effective communications	(h) understanding the impact of engineering solutions	(i) life-long learning	(j) knowledge of contemporary issues	(k) use of techniques, skills, and modern engineering tools in design	(l) design a system through integration of hardware and software	
COE 202 & 203 Digital Logic Design	A	X	X	X			X				X		1
COE 300 Principles of Comp. Eng. Design	X	X	X	X	X	A	X	A	X	A	X	X	3
COE 301 Computer Organization		A	A	X							X		2
COE 306 Introduction to Embedded Systems	X	A	X	X	A				X		X	A	3
COE 241 Data & Comp. Communications	A		X		X						X		1
COE 344 Computer Networks	A	A			X					X	X		2
COE 351 COE Coop Training	X		X	A	X	A	A	X	A	X	A	A	6
COE 399 COE Summer Training				A		A	A		A		A		5
COE 485 Senior Design Project	X	X	A	A	A	X	X	A	A	A	A	A	8
Depth Elective Course 1: COE 444 Inter. Design and Management	X		A		A						A		3
Depth Elective Course 2: COE 405 Des. and Modeling of Digital Sys.	X		A		A						A		3
													37
Total	3	3	4	3	4	3	2	2	3	2	5	3	37
Total per student (Since students will take one course or the other [351 or 399] and [444 or 405])	3	3	3	2	3	2	1	2	2	2	3	3	29

Table 2. Student outcomes and the courses used to assess them

Student Outcome	Courses Used to Assess it		
(a) Apply knowledge of mathematics, science, and engineering	COE 202	COE 241	COE 344
(b) Design and conduct experiments, analyze and interpret data	COE 301	COE 306	COE 344
(c) Design a system, component, or process to meet desired needs	COE 301	COE 485	COE 444 / COE 405
(d) Function on multi-disciplinary teams	COE 351 / COE 399	COE 485	
(e) Identify, formulate, and solve engineering problems	COE 306	COE 485	COE 444 / COE 405
(f) Understanding of professional and ethical responsibility	COE 300	COE 351 / COE 399	
(g) Effective communications	COE 351 / COE 399		
(h) Understanding the impact of engineering solutions	COE 300	COE 485	
(i) Life-long learning	COE 351 / COE 399	COE 485	
(j) Knowledge of contemporary issues	COE 300	COE 485	
(k) Use techniques, skills and modern tools necessary for engineering practice	COE 444 / COE 405	COE 351 / COE 399	COE 485
(l) Design a system through integration of hardware and software	COE 306	COE 351	COE 485

2. Assessment Plan for the cycle T131-T142

Appendix 3 shows the plan developed for the 2-year assessment cycle covering terms T131-T142 for the new curriculum, based on the information given in Section 1. The cycle asses only 6 outcomes per semester as opposed to attempting to assess all the 12 outcomes in earlier cycles, e.g. see the COE ABET Activity report for term 112. This change was introduced to enhance sustainability of the ABET assessment processed as recommended by feedback received from the KFUPM ABET Steering Committee on the COE ABET Activity report for term 112. The plan calls for assessing outcomes c, f, g, h, j, L in the Fall Semester and outcomes a, b, d, e, i, k in the Spring Semester. Due to the low enrollment at present in the COE 351/COE 399 course pair, it was decided to collect rubrics scores data for all student outcomes assessed by this course pair every time a course is offered. These outcomes are: d, g, i, k, and L. When an outcome in this set is not scheduled for assessing in a given semester, the scores collected will be added to those collected in the following semester for improved statistics.

3. Corrective Actions and Continuous Improvement

3.1. Corrective Actions Mandated by the COE Council in T131

Upon discussing the results of the T122 student outcome assessment in the COE council meeting #7/1434-135H held on Monday October 28, 2013, the Council has mandated the following corrective actions:

1. For the COE 202, 241, 301, 306, and 344 Courses:

   i. Use common syllabus and adopt Close coordination (common exams) for multiple section offerings
   ii. Organize problem-solving sessions to be attended by all students

2. For the COE 351 & 399 Courses:

   Students should present their work in formal public presentations and the event will be announced in advance at the department and college level.

Action 1(i) has been regularly implemented for several semesters in course COE 202 which was the only multi-section course offered by the department in T131.

Based on the Council recommendations, Action 1(ii) was implemented in 3 out of the 5 courses specified. Two to four problem solving sessions were offered in each of these courses, but attendance was on voluntary basis due to difficulties faced in assigning such sessions at class or lab times. Several such sessions attracted good attendance, and some COE 202 instructors reported improvements in the achievement ratings for course outcomes in end-of-semester course evaluation by students, which could be partially attributed to the problem solving sessions. In one of the remaining two courses, normal classes contained enough problem solving material and it was felt that extra dedicated sessions were not required.

Action 2 will be implemented starting T 132.

3.2. Corrective Actions Initiated by the ABET Committee during T131

The ABET Committee has initiated and overseen the implementation of a number of corrective actions designed to improve the learning and assessment processes at the COE program. These are described in this section.

3.2.1. Enhancing the lab contents/ manuals for the new courses COE 301 and COE 306

Based on recommendations from instructors of the labs of some of the new courses in the COE curriculum, the ABET committee initiated action to improve the quality of the content and manuals for these new labs. The issue was communicated to the Chairman of the COE Curriculum Committee and the COE Lab Coordinator who held a number of meetings with the lecture and lab instructors of the COE 301 and the COE 306 courses. A plan was setup for rewriting most of the lab experiments and the manuals for the labs in both courses.

Status report on progress at the end of T 131 indicated the following:

COE 301 Lab:

Seven out of the present set of 10 experiments for this lab have been documented in a new lab manual.

COE 306 Lab:

Two major experiments using a new (ARM) board were developed and documented and work on eight more experiments is in progress.

3.2.2. Improving learning and assessment in the COE 485 (Senior Design Project) Course

The COE 485 is the only capstone project course in the new curriculum where the learning of most student outcomes is expected to culminate shortly before graduation. The course covers all the 12 student outcomes (See Appendix 2) and is used to assess 8 of them, namely outcomes c, d, e, h, i, j, k, and L, see Table 1. The following corrective actions have been introduced this semester:

a. A template for the contents of the COE 485 final report was developed by the ABET Committee and circulated for comments and improvements by the Curriculum Committee and COE Faculty who taught the course before. The template aims to ensure that key student outcome are addressed throughout the project in order to enhance learning and facilitate assessment. The final version of the template, see Appendix 4, was given to the students well before they started writing their reports in T131.

b. A set of guidelines to COE faculty considering proposing a design project for the COE 485 was prepared to ensure that the project involves a rich design experience and addresses all key outcomes associated with the course, see Appendix 5. This set of guidelines will be used to select projects for the course in T 132.

c. Improving course assessment by introducing multiple examiners and ensuring greater emphasis and publicity for the final project presentations by the students.

3.2.3. Improving learning and assessment in COE 351 (COOP Training) and COE 399 (Summer Training)

Similarly, the ABET committee felt that the COE 351 and COE 399 courses should benefit from templates for their final reports which highlight expected outcomes from the CCOP and summer training. The Committee reported this to the COE Chairman who assigned the COE 351/COE 399 to prepare draft templates.

3.2.4. Improving ABET Visibility for the COE Community

The ABET Accreditation page on the COE Website has been updated, and useful information related to new curriculum were posted for the benefit of the COE community, including the program's Student Outcomes, the outcomes-to-courses mapping for the new curriculum, the Assessment Plan for the cycle T131-T142, the Assessment Rubrics, Rubrics scoring templates, and previous COE ABET activity reports. Current information on student enrolment and number of graduates from the program were also provided.

3.2.5. Improving ABET Reporting, Documentation, and Archiving

a. A set of new templates were developed by the ABET Committee for use by instructors and Outcome Coordinators in the ABET Committee. These included:
    i. Excel sheet template for filling in rubrics scores for an outcome assessed by a course instructor (Appendix 6).
    ii. Template for preparing a Student Outcome Assessment Report by a course instructor, to be included as part of the Course File. This template now forms Section 10 of the standard course file template distributed by the COE Department Office to all instructors towards the end of each semester (Appendix 7).
    iii. Excel sheet template for calculating outcome assessment score by an Outcome Coordinator (of the ABET Committee) using scores obtained from several courses (Appendix 8).
    iv. Template for preparing the Student Outcome Report by the Outcome Coordinator (Appendix 9).

b. Introduced twelve Student Outcome folders in the ABET data room for archiving the student outcome reports and follow up relevant corrective actions during the assessment cycle T131-T142.

4. Direct Assessment

As per the Student Outcome Assessment Plan for the cycle T131-T142 (Appendix 3), direct assessment and evaluation were carried out for the following six student outcomes during the reporting period:

i. Outcome (c): Ability to design a system, process, or component to meet desired needs subject to given constraints. Analyze and evaluate alternative solutions.

ii. Outcome (f): Ability to understand professional and ethical responsibilities. Demonstrate ethical practice.

iii. Outcome (g): Ability to use oral, written, and audio-visual techniques effectively for successful communication.

iv. Outcome (h): Understanding of the impact of engineering solutions in a global, economic, environmental, and societal context.

v. Outcome (i): Knowledge of contemporary socio-economic issues relevant to computer engineering.

vi. Outcome (L): Ability to design a system that involves the integration of hardware and software

Moreover, assessment data for outcomes d, i, and k were collected from the courses COE 351 and COE 399. This data will be assessed and evaluated together with the data that will be collected for these outcomes during T132, according to the Assessment Plan. This data is not considered in this report.

4.1. Assessment

The assessment of each outcome was carried out in the subset of courses serving the outcome as shown in Table 2 and indicated in the Assessment Plan (Appendix 3). Early in the semester, instructors of these courses were provided with the rubrics of the relevant student outcomes and requested to furnish the ABET Committee with their plans for assessing the outcome(s) in their respective courses. In particular, they were asked to show how they will obtain student scores for the various clauses of the rubrics and what supporting evidence they will provide in terms of student work. Response from the instructors was discussed in the ABET Committee and, where applicable, comments were communicated back to instructors. The final plans for assessing the six outcome outcomes in the respective courses are given in the Outcome Assessment Reports provided in Appendix 10.

Towards the end of the semester, each course instructor implemented the approved plans for assessing the outcomes in his respective courses, used the Rubrics Scoring template (Appendix 6) to record the scores, and prepared a Student Outcome Assessment Report (Appendix 7) for each outcome assessed. The report included the rubrics scores and provided an account of the assessment method used, the evidence provided, and gave comments on the assessment results and suggestions for corrective actions for improvements in both the outcome learning and the assessment process. In the ABET Committee, Outcome Coordinators oversaw the implementation of the assessment plans in the courses relevant to their outcome(s), and were furnished with copies of the Student Outcome Assessment Reports from the respective instructors for such outcome(s). Outcome Coordinators then prepared a global Student Outcome Assessment Report (Appendix 9) for each outcome, which combined assessments for that outcome from individual courses and summarized the course-based results, comments, and proposed corrective actions. Appendix 10 contains the seven global student outcome reports prepared, as two

separate reports were generated for outcome g-W (Written communication skills) and outcome g-O (Oral communication skills).

Table 3 lists all courses used for assessment, the number of students, and course-based scores and global scores for the six outcomes assessed. Separate entries are used for the two aspects of outcome g, namely g-W and g-O for written and oral communication skills, respectively. All outcome scores are on a scale of 0-4. The Table also shows the level of achievement of each student outcomes based on the following criteria adopted by the COE Program:

- Achieved (A): Score > 2.5,
- Marginally Achieved (M): Score: ≈ 2.5
- Need Improvement (NI): Score < 2.5

Table 3. Courses used, number of students, course-based scores, global scores, and achievement levels for the six student outcomes assessed during the report period.

Student Outcome	Course	Number of Students	Course-Based Outcome Score	Total # of students	Global Outcome Score	Achievement Level
(c) Design	COE 301	8	3.21	34	3.08	A
	COE 405	11	3.30			
	COE 444	10	2.94			
	COE 485	5	2.64			
(f) Ethics	COE 351	5	3.20	19	2.50	M
	COE 399	4	2.75			
	COE 300	10	2.15			
(g-W) Communication-Written	COE 351	5	2.10	15	2.28	NI
	COE 399	10	2.37			
(g-O) Communication- Oral	COE 351	5	2.90	15	2.63	A
	COE 399	10	2.49			
(h) Impact of Engineering Solutions	COE 485	5	2.33	15	2.53	M
	COE 300	10	2.64			
(j) Contemporary Issues	COE 485	5	2.00	15	2.40	NI
	COE 300	10	2.59			
(L) Integration of Hardware & Software	COE 306	9	3.45	19	3.03	A
	COE 351	5	2.50			
	COE 485	5	2.80			

4.2. Evaluation

Assessment results in Table 3 indicate that outcomes c, g-O, and L were adequately achieved, while outcomes f and h were marginally achieved. However, the global score for outcomes g-W and j fell below 2.5 and therefore these two outcomes need improvement.

Table 4 compares the assessment results for the latest available results for the same outcomes, which are derived from the COE Activity Report for T 112 (the last term the old curriculum was used). Comparison indicates a significant improvement in outcome c and a modest improvement in outcome j. However, significant deterioration has affected the achievement level of outcomes f and g-W.

Although the new curriculum provided better in-depth treatment of many of the 'soft' student outcomes such as contemporary issues, societal impact of engineering solutions, professional and ethical responsibilities, the assessment scores suggest that these outcomes were better achieved in the old curriculum as observed from comparing assessment results from term 112 to term 131. This, however, could be attributed to the following factors:

1) In the old curriculum, these outcomes were not injected deeply enough as in the new curriculum due to the lack of an appropriate course. As such, they were also assessed based on limited students' activities, hence the higher scores,

2) Also, due to the low student enrollment in the department, the assessment results become very sensitive to the student sample currently enrolled. This leads to greater fluctuations in the assessment results from one term to another and even from one course to another.

Table 4. Compares of the assessment results for the student outcomes assessed this semester with the latest results when the same outcomes were assessed in T 121.

Semester	Student Outcome						
	c Design	f Ethics	g-W Comm. (Written)	g-O Comm. (Oral)	h Impact	j Contemporary	L Integrate
T112	2.40	3.00	2.87	2.80	2.76	2.11	3.83
T131	3.08	2.5	2.28	2.63	2.53	2.4	3.03

4.3. Comments

Outcome c (Design):

- COE 485: Introducing the final project template appears to have enabled the students to prepare better reports and presentations.

Outcome f (Ethics):

- Assessors for COE 351/COE 399 did not have a reliable platform to observe the students' understanding of their professional and ethical responsibilities.
- Assessment in COE 300 showed that students do not see ethical conduct as part of their responsibilities as professional engineers, but rather something they would do out of their 'good' nature or beliefs – They did not fully appreciate that extent of their professional responsibilities toward their clients.

Outcome g-W (Communication- Written):

- The outcome needs quite a bit of improvement.

Outcome g-O (Communication- Oral):

- The outcome was achieved but with a narrow margin.

Outcome h (Impact of Engineering Solutions):

- The outcome was barely achieved.
- Compared to COE 300, results from COE 485 were much worse. This is because almost all of the COE 485 students are from the old curriculum which did not provide sufficient exposure to the impact of engineering solutions.
- The introduction of COE 300 in the new curriculum is expected to improve the situation, but as suggested by the COE 300 results, that alone might not be sufficient.

Outcome j (Contemporary Issues)

- The outcome needs quite a bit of improvement.
- Compared to COE 300, results from COE 485 were much worse. This is because almost all of the COE 485 students are from the old curriculum which did not provide sufficient exposure to contemporary issues and their relationship to Computer Engineering.
- The introduction of COE 300 in the new curriculum is expected to improve the situation, but as suggested by the COE 300 results, that alone might not be sufficient.

Outcome L (Integration of Hardware & Software):

- This outcome was adequately achieved in COE 306 and COE 485. However, it was only marginally achieved in COE 351 (COOP Training). This may be mainly because not many companies that host COE COOP students engage them in projects that involve the integration of hardware and software. Many COOP projects are software-oriented, and are not suitable for assessing outcome L.
- It was noticed that some COE 485 projects involve little integration of hardware and software.

4.4. Proposed Corrective Actions

Outcome c (Design):

General:

- Progressively inject engineering design (ED) methodology in every lab activity in the COE program and present a comprehensive ED methodology (integrating all aspects) in the COE 300 course.

COE 485:

- Provide a repository of project proposals by faculty and make it available to students to browse through and select from.
- Finalize the selection of projects for next semester towards the end of the current semester. This helps with timely procurement of components and allows early start of projects.
- Course coordinator should ensure that students attend weekly meetings with their project advisor for timely guidance and feedback.
- Implement regular evaluation of project progress by the project advisor and the course coordinator for early detection of potential problems.
- Ensure adequate technical documentation to allow reproducibility and continuation. Give particular emphasis to documenting interfaces to encourage and simplify reuse.
- Emphasize modularity.
- Archive all outcomes of completed projects and allow students to continue developing them or use them as components in larger projects.
- Train students to consider multiple options and document design decisions. Such options may include taking an existing solution and extending it.
- Provide guidelines for screening the project proposals offered by faculty.

COE 301:

- Reduce the structuring of the COE 301 lab project to avoid the problem that work by the different teams is similar, and many engineering design fundamentals are only addressed indirectly and not reported.
- The lab should be organized in a way to provide an environment for developing student experience and show the strengths and weaknesses in carrying out an engineering design project, including their ability to learn on their own and use design tools.

COE 405:

- Cover more design examples in the class.
- Introduce project proposals formulated to emphasize important design aspects such as exploring alternative solutions and meeting design constraints.

COE 444:

Improve the way "alternative solutions" are addressed, e.g. by:

- Explaining the concept in class and then discuss it with the students through some examples.
- Giving the students a network design problem with a limited scope, and have them present their proposed designs in the class. This is then followed by a discussion in the class about different alternatives for designing the network.

Outcome f (Ethics):

- COE 351 & COE 399: Identify tangible assessable components that demonstrate the students' understanding of their professional and ethical responsibilities. Otherwise, these courses can't be used to assess Student Outcome f.
- COE 300: Students should be given more lectures on professional & ethical responsibilities of computer engineers. They also need to be taught the negative impact of unprofessional and unethical conduct, on their persons, employers and the whole society.

Outcome g-W (Communication- Written):

- Request the help of the English language department, and ask them to revise English courses to better prepare students for technical writing.
- Evaluate and provide feedback to students on the writing aspects of the reports they prepare throughout the program, e.g. course project reports.

Outcome g-O (Communication- Oral):

- Introduce more oral presentations by students in several courses throughout the program, e.g. courses that require projects reports.
- It is important to provide feedback to students on the communication aspects of their presentations, and not limit feedback only to the technical content.

Outcome h (Impact of Engineering Solutions):

- Inject "impact of engineering solutions" in several courses. For example, in courses involving projects, students must be asked to reflect on the socio-economic impact of their solutions.

Outcome j (Contemporary Issues):

- Inject the culture of recognizing global issues in English/Arabic courses where students routinely write essays related to their majors.
- We recommend that the KFUPM ABET Steering Committee formally requests the English Language department at KFUPM to address global issues, particularly those related to engineering disciples, in course readings and essay writing activities by the department. This should help improve this outcome across may ABET accredited KFUPM programs.
- COE faculty should consider commenting on such issues whenever an opportunity arises in any course in order to reinforce the role of engineers in tackling various contemporary issues. Also, senior project supervisors should explain this outcome to their students and discuss how their projects relate to it.

Outcome L (Integration of Hardware & Software):

COE 351

- Clarify and highlight to both students and companies the importance of addressing this outcome in the COOP training. Reflect this in the proposed COOP Report template.
- Request, in advance, clear and specific plans for the COOP training from companies offering COOP training opportunities for COE students.
- Favor COOP offers where training involves adequate level of hardware and software integration.
- Consider limiting the assessment of outcome L to COOP students who experienced the integration of hardware and software during their training.

COE 306

- Ensure that both the lab and course go in line using the same platform and that the project is discussed in class as part of the course requirement.
- Improve the lab component and switch to the ARM Cortex-M family boards.

COE 485

- Clarify and highlight to the course coordinator, project proposers/advisers and students the importance of addressing this outcome in COE 485 projects. Reflect this in both the guidelines for proposing a COE project and the template for the final report.

Appendix 1: New COE BS in Computer Engineering Curriculum (Summer Training Option)

COURSE	TITLE	LT	LB	CR	COURSE	TITLE	LT	LB	CR
Preparatory Year									
ENGL 001	Prep. English I	15	5	8	ENGL 002	Prep. English II	15	5	8
MATH 001	Prep. Math I	3	1	4	MATH 002	Prep. Math II	3	1	4
PYP 001	Prep. Physical Science	2	0	2	PYP 002	Prep. Computer Science	0	2	1
PYP 003	University Study Skills	0	2	1	ME 003	Prep. Eng. Technology	0	2	1
PE 001	Prep. Health and Physical Educ. I	0	2	1	PE 002	Prep. Health and Physical Educ. II	0	2	1
		20	**10**	**16**			**18**	**12**	**15**
Total credit hours required in Preparatory Program: 31									
First Year (Freshman)									
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
ENGL 101	Intro. to Academic Discourse	3	0	3	ENGL 102	Intro. to Report Writing	3	0	3
CHEM 101	General Chemistry I	3	4	4	ICS 102	Intro. to Computing I	2	3	3
IAS 111	Belief and its Consequences	2	0	2	IAS 101	Practical Grammar	2	0	2
PE 101	Health and Physical Educ. I	0	2	1	PE 102	Health and Physical Educ. II	0	2	1
		15	**9**	**18**			**14**	**8**	**17**
Second Year (Sophomore)									
COE 202	Digital Logic Design	3	0	3	ICS 202	Data Structures	3	3	4
COE 203	Digital Logic Design Lab	0	3	1	EE 203	Electronics I	3	3	4
ICS 201	Intro. to Computing II	3	3	4	IAS 212	Professional Ethics	2	0	2
EE 202	Electric Circuits I	3	0	3	COE 241	Data and Comp. Communications	3	0	3
EE 212	Electric Circuits Laboratory	0	3	1	STAT 319	Prob. & Stat. for Eng. & Sci.	2	3	3
MATH 201	Calculus III	3	0	3					
IAS 201	Objective Writing	2	0	2					
		14	**9**	**17**			**13**	**9**	**16**
Third Year (Junior)									
MATH 260	Intro. to Diff. Eqs. & Lin. Alg.	3	0	3	COE 306	Intro. to Embedded Systems	3	3	4
ICS 253	Discrete Structures I	3	0	3	IAS 301	Language Comm. Skills	2	0	2
ENGL 214	Academic & Professional Comm.	3	0	3	COE 4xx	COE Depth Elective	3	0	3
COE 301	Computer Organization	3	3	4	XE xxx	Technical Elective I	3	0	3
COE 344	Computer Networks	3	3	4	COE 300	Principles of Comp. Eng. Des.	1	3	2
					ISE 307	Eng. Economic Analysis	3	0	3
		15	**6**	**17**			**15**	**6**	**17**
Summer Session					COE 399	Summer Training	**0**	**0**	**0**
Fourth Year (Senior)									
ICS 431	Operating Systems	3	3	4	COE 485	Senior Design Project	1	6	3
COE 4xx	COE Elective I	3	0	3	IAS 322	Human Rights in Islam	2	0	2
COE 4xx	COE Elective II	3	0	3	COE 4xx	COE Elective III	3	0	3
XE xxx	Technical Elective II	3	0	3	COE 4xx	COE Elective IV	3	0	3
GS xxx	GS Elective 1	3	0	3	GS xxx	GS Elective II	3	0	3
		15	**3**	**16**			**12**	**6**	**14**
Total credit hours required in Degree Program : 132									

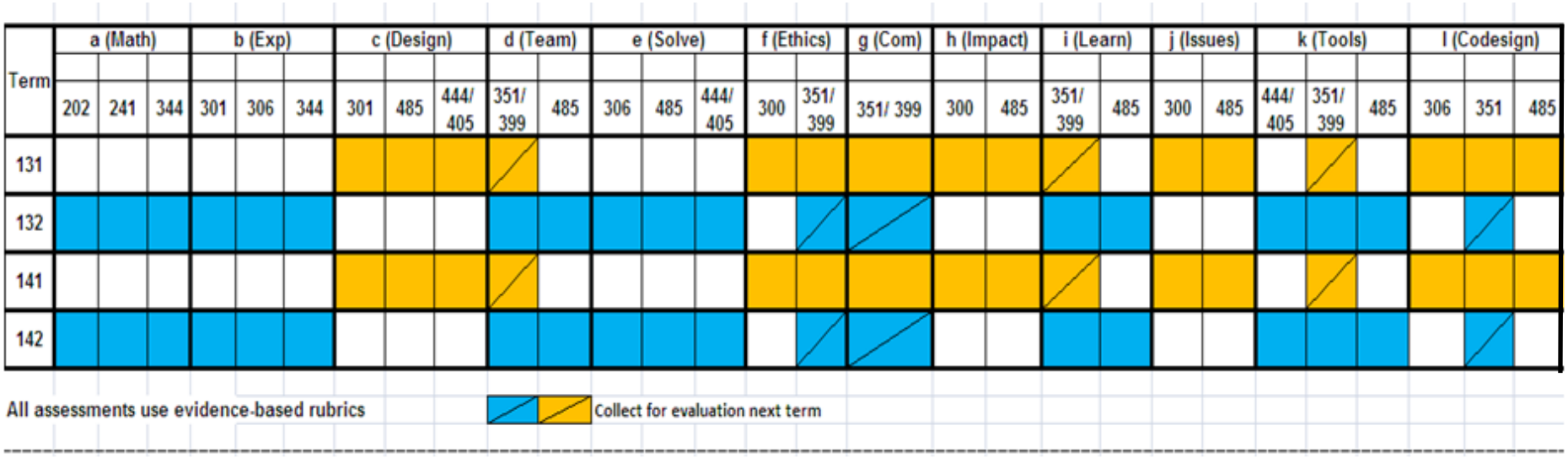
Appendix 1, Contd.: New COE BS in Computer Engineering Curriculum (COOP Option)

COURSE	TITLE	LT	LB	CR	COURSE	TITLE	LT	LB	CR
Preparatory Year									
ENGL 001	Prep. English I	15	5	8	ENGL 002	Prep. English II	15	5	8
MATH 001	Prep. Math I	3	1	4	MATH 002	Prep. Math II	3	1	4
PYP 001	Prep. Physical Science	2	0	2	PYP 002	Prep. Computer Science	0	2	1
PYP 003	University Study Skills	0	2	1	ME 003	Prep. Eng. Technology	0	2	1
PE 001	Prep. Health and Physical Educ. I	0	2	1	PE 002	Prep. Health and Physical Educ. II	0	2	1
		20	**10**	**16**			**18**	**12**	**15**
Total credit hours required in Preparatory Program: 31									
First Year (Freshman)									
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
ENGL 101	Intro. to Academic Discourse	3	0	3	ENGL 102	Intro. to Report Writing	3	0	3
CHEM 101	General Chemistry I	3	4	4	ICS 102	Intro. to Computing I	2	3	3
IAS 111	Belief and its Consequences	2	0	2	IAS 101	Practical Grammar	2	0	2
PE 101	Health and Physical Educ. I	0	2	1	PE 102	Health and Physical Educ. II	0	2	1
		15	**9**	**18**			**14**	**8**	**17**
Second Year (Sophomore)									
COE 202	Digital Logic Design	3	0	3	ICS 202	Data Structures	3	3	4
COE 203	Digital Logic Design Lab	0	3	1	ICS 253	Discrete Structures I	3	0	3
ICS 201	Intro. to Computing II	3	3	4	EE 203	Electronics I	3	3	4
EE 202	Electric Circuits I	3	0	3	IAS 212	Professional Ethics	2	0	2
EE 212	Electric Circuits Laboratory	0	3	1	COE 241	Data and Comp. Communications	3	0	3
MATH 201	Calculus III	3	0	3	STAT 319	Prob. & Stat. for Eng. & Sci.	2	3	3
IAS 201	Objective Writing	2	0	2					
		14	**9**	**17**			**16**	**9**	**19**
Third Year (Junior)									
MATH 260	Intro. to Diff. Eqs. & Lin. Alg.	3	0	3	COE 306	Intro. to Embedded Systems	3	3	4
ENGL 214	Academic & Professional Comm.	3	0	3	COE 4xx	COE Depth Elective	3	0	3
IAS 301	Language Comm. Skills	2	0	2	GS xxx	GS Elective I	3	0	3
COE 301	Computer Organization	3	3	4	COE 300	Principles of Comp. Eng. Des	1	3	2
COE 344	Computer Networks	3	3	4	ICS 324	Database	3	3	4
ISE 307	Eng. Economic Analysis	3	0	3	IAS 322	Human Rights in Islam	2	0	2
		17	**6**	**19**			**15**	**9**	**18**
Summer Session					COE 350	Begin Cooperative Work	**0**	**0**	**0**
Fourth Year (Senior)									
COE 351	Cooperative Work	0	0	9	COE 485	Senior Design Project	1	6	3
					ICS 431	Operating Systems	3	3	4
					COE 4xx	COE Elective I	3	0	3
					COE 4xx	COE Elective II	3	0	3
					GS xxx	GS Elective II	3	0	3
		0	**0**	**9**			**13**	**9**	**16**
Total credit hours required in Degree Program : 133									

Appendix 2: Courses and their Coverage of Student Outcomes in the new COE Curriculum

Course / Outcome	(a) apply knowledge of mathematics, science	(b) design and conduct experiments, analyze data	(c) design a system, c to meet desired needs	(d) function on multi-disciplinary teams	(e) identify, formulate, and solve engineering problems	(f) understanding of professional ethics	(g) effective communications	(h) understanding impact of engineering solutions	(i) life-long learning	(j) knowledge of contemporary issues	(k) use of techniques, skills, and modern tools in design	(l) design a system by integrating hardware & software
MATH 101, MATH 102, MATH 201, MATH 260, PHYS 101, PHYS 102 and CHEM 101	X											
STAT 319 Prob. & Stat. for Engineers	X											
ENGL & IAS courses							X					
IAS 212 Professional Ethics						X						
ICS 102, ICS 201, ICS 202 and ICS 431			X	X							X	
ICS 253 Discrete Structures I	X											
EE 201 Electric Circuits I	X	X										
EE 203 Electronics I	X	X	X	X							X	
SE 307 Eng. Economics Analysis											X	
COE 202 & 203 Digital Logic Design	X	X	X	X			X				X	
COE 300 Principles of Comp. Eng. Design	X	X	X	X	X	X	X	X	X	X	X	X
COE 301 Computer Organization		X	X	X							X	
COE 306 Introduction to Embedded Systems	X	X	X	X	X				X		X	X
COE 241 Data & Comp. Communications	X		X		X						X	
COE 344 Computer Networks	X	X			X					X	X	
COE 351 COE COOP Training	X		X	X	X	X	X	X	X	X	X	X
COE 399 COE Summer Training				X		X	X		X		X	
COE 485 Senior Design Project	X	X	X	X	X	X	X	X	X	X	X	X
Depth Elective Courses:												
COE 444 Inter. Design and Management	X		X		X						X	
COE 405 Des. and Modeling of Digital Sys.	X		X		X						X	

Appendix 3. Assessment Plan for the Students Outcomes with the new Curriculum over the Cycle T131-T142



Appendix 4. Template for the Final Report of COE 485 Projects

1. **Introduction:**
   - Introduce the issue the project deals with (e.g. rising cost of health care, environment …etc.)
   - and why is it an issue (provide supporting evidence; government statistics, news/magazine/journal articles …etc.).

2. **Problem Statement:**
   - State the problem the project is supposed to solve –
   - why was the project conducted, why do we need it.
   - Also in a separate sub-section (call it **2.2 Project Impact**) state the potential impact of the project on society (locally and globally), both positive impact and possible negative impact (due to misuse or unaccounted for risks).

3. **Project Specifications:**
   - State the needs of the customers (who will use/benefit from your project)
   - Show how the needs are translated to specific requirements (specifications) for the project such that the design would solve the problem and satisfy the needs.
   - Example of specifications; speed, response time, range, accuracy, …etc.

4. **Team Work:**
   - Show the contribution of each team member and the special experience/talent each team member brought into the project.

5. **Engineering Design:**
   Completely document the project design:
   - State the design options that were examined, criteria used to select the chosen approach,
   - Explain the concept you used to implement the project, and use many graphical illustrations to explain your points,
   - Explain the tradeoffs you made,
   - Make sure you state the limitations/constraints of your approach,
   - Explain the main SW code(s) in your project (flow charts and put the code in an appendix),
   - List the ready-made components (both software and HW) you have used (e.g. Arduino libraries ...etc.),
   - HW and SW components that were developed or used and the final integration of all components.

6. **Engineering Tools & Standards:**
   - Describe the different tools used in the project (simulators, software, emulators, boards, development environments IDEs …etc.) and where/how they were used.
   - Describe the different standards you have used/utilized in your design (e.g. Xbee, UART ...etc.) -- state these standards and where you used them (e.g. communication between so and so).

7. **Reflections**: What was learned, conclusions, what would you do differently if you had to do a similar project or solve a similar problem

Appendix 5. Guidelines for Proposing a COE 485 Project

The COE 485 Senior Design Project represents the only capstone course in the current COE curriculum. Most of the program's outcomes are mapped to this course, hence it is important to formulate the project requirements such that all of these outcomes are injected and assessed. The following guidelines help achieve the goals of the COE 485 senior design project course:

1. The project should be a design or a design analysis type; students would design a product or a service, or analyze an existing solution to identify weaknesses and propose improvements. A prototype must be produced.

2. The project should not be specific, where there is only one clear solution. It should be a general problem. Students must identify the requirements, formulate them into specifications, identify different solutions, choose one based on specific, documented criteria, and then implement it.
3. The implemented solutions must involve integrating hardware and software components. Components may be standard, ready-made components, e.g. web server, database server, UART, as well as custom component designed by the students, e.g. microcontroller software, application server, FPGA-based design.
4. The project must involve the use of engineering tools, e.g. simulators, CAD tools, formal descriptions, standard benchmarks, and must refer to and employ standards, e.g. IEEE 802.11p, CAN, I2C.
5. The project should deal with one or more contemporary issues, e.g. rising cost of health care, education, energy, environment. Students must demonstrate how they can, as computer engineers, contribute solutions (products/services) that eases people concerns.
6. Finally, students must assess the impact of their solution, both its intended impact, e.g. efficiency, low-cost from automation, low-cost business overhead due to cheap communication via computer networks, and the unintended negative impacts that may result from the deployment or use of their solution, e.g. privacy issues, security issues.

Appendix 6. Template/Example Excel Sheet for Filling in Rubrics Scores for an Outcome

Outcome, Course, Semester	g		COE 351	T131										
Number of Students	10													
Prepared by:	Name of Faculty		Date:	07-Dec-13										
					Student ID									
Outcome	**Avg.**	**Min.**	**Max.**	**Std. Dev.**	**2869420**	**2828640**	**2881840**	**2881620**	**2759010**	**2825040**	**2830740**	**2849500**	**2859240**	**2874960**
Audience awareness	2.80	1.00	4.00	1.03	2.00	4.00	2.00	3.00	4.00	3.00	1.00	4.00	2.00	3.00
Focus	2.35	1.00	4.00	0.88	2.00	4.00	1.50	3.00	2.00	2.00	1.00	3.00	3.00	2.00
Transitions	2.40	1.00	4.00	0.84	2.00	4.00	2.00	3.00	2.00	2.00	1.00	3.00	2.00	3.00
Use of visual aids	2.35	1.00	4.00	0.88	2.00	4.00	1.50	3.00	2.00	2.00	1.00	3.00	3.00	2.00
Mechanics	**Avg.**	**Min.**	**Max.**	**Std. Dev.**	**2869420**	**2828640**	**2881840**	**2881620**	**2759010**	**2825040**	**2830740**	**2849500**	**2859240**	**2874960**
Body position	2.50	1.00	4.00	0.97	2.00	4.00	2.00	3.00	4.00	2.00	1.00	3.00	2.00	2.00
Eye contact	2.40	1.00	4.00	1.07	2.00	4.00	2.00	3.00	4.00	1.00	1.00	3.00	2.00	2.00
Visual aids	3.00	2.00	4.00	0.82	4.00	4.00	2.00	3.00	4.00	2.00	3.00	3.00	3.00	2.00
Delivery	2.60	1.00	4.00	0.84	3.00	4.00	3.00	3.00	3.00	2.00	1.00	3.00	2.00	2.00
Questions	**Avg.**	**Min.**	**Max.**	**Std. Dev.**	**2869420**	**2828640**	**2881840**	**2881620**	**2759010**	**2825040**	**2830740**	**2849500**	**2859240**	**2874960**
Asks audience for questions	2.10	1.00	4.00	1.29	3.00	4.00	1.00	3.00	4.00	1.00	1.00	2.00	1.00	1.00
Answers questions effectively & smoothly	2.30	1.00	4.00	0.95	3.00	4.00	1.00	3.00	3.00	2.00	1.00	2.00	2.00	2.00

Appendix 7. Template for preparing a Student Outcome Assessment Report for a Course

10. ABET STUDENT OUTCOME ASSESSMENT REPORT(S)

(TERM-131)

Instructions:

- This section is required only if an ABET student outcome is assessed in this course this semester. See the COE student outcome assessment plan here

- Complete a separate assessment report for each outcome assessed. Do not duplicate the evidence if it serves multiple outcomes

- The report should combine assessments of the outcome from all course components, including lab components

- See next page for guidelines on the contents required for a student outcome assessment report

Contents of Student Outcome Assessment Report

1. An outline of the assessment method(s) used to assess the outcome and determine the scores for the various clauses of the rubrics for the students.

2. Copies of all that you have provided to the students in connection with the assessment: e.g. specific questions/ problems, description of assignments, report templates/ guidelines, etc. Indicate on each item the outcome and rubrics clause it was used to assess.

3. Marked-up copies of all the evidence provided by the students in connection with the assessment, which may include:

i. Student answers to specific questions/ problems
ii. Term papers, assignments
iii. Final reports for projects/ coop/ summer training
iv. Final presentations for project/ coop/ summer training (copies of the slides/ videos of the presentation on CD)
v. Demos of projects (on CD)

Each evidence item should be clearly marked to indicate:

- The student ID(s)
- The relevant outcome and outcome clause

4. An Excel sheet of detailed scores for individual students on each rubrics clause. Use student IDs to identify students. The sheet should also indicate the number of students assessed and give summary statistics (Average, Min, Max, and standard deviation) for the batch of students (for individual rubrics clauses and overall). Include only COE students. If the rubrics are based on group activities, e.g. a project, assign the group score to each student in the group. Please use the example excel sheet for outcome (g) available here as a template.

5. Your comments and observations on the results, areas of strengths and weaknesses.

6. Your suggestions for corrective actions to:

i. Improve student learning of the outcome in your course and in general
ii. Improve the outcome assessment plan/procedure itself.

Appendix 8. Template/Example Excel Sheet for Calculating Outcome Score from Assessments in Multiple Courses

	Outcome	g-W		Semester	T131
	Prepared by:	Name of Outcome Coordinator		Date:	07-Dec-13
	Courses Contributing to Outcome Assessment	Number of Students	Average from Course		
1	COE 351	15	2.00		
2	COE 399	10	3.00		
3					
	Total	25	2.40		
			Outcome Average		

Appendix 9. Template for preparing the Student Outcome Report by the Outcome Coordinator

Outcome Assessment Report	(Covers 2 Courses)		
Outcome	g-W	Semester	131
Prepared by:	Outcome Coordinator	Date:	

1. Summary of Course Reports:

Course	Number of Students	Average Outcome Score	Assessment Method*	Evidence Provided	Comments*	Proposed Corrective Actions*
COE 351	15	2.00				
COE 399	10	3.00				
Total	25	2.40	* Summarized as is from course instructor's reports			
		Weighted Average				

2. Comments:

Your overall Comments on Outcome Achievement, Weaknesses in certain outcome aspects, Weaknesses in certain courses, ...
Score > 2.5: Achieved (A), Score: ≈ 2.5: Marginally Achieved (M), Score < 2.5: Need Improvement (NI)

3. Corrective Actions:

List specific suggested corrective actions ranked in order of importance, practicality, and potential impact (bullet points)

Appendix 10. Student Outcome Reports for Outcome c, f, g-W, g-O, h, j, and L.

Report for Student Outcome c

Outcome Assessment Report	(Covers 3 Courses)		
Outcome	**C**	**Semester**	**131**

Prepared by:	Mohammed Sqalli	Date:	February 5, 2014

1. Summary of Course Reports:

Course	Number of Students	Average Outcome Score	Assessment Method*	Evidence Provided	Comments*	Proposed Corrective Actions*
COE 301	**8**	**3.21/4**	Engineering design aspects are addressed through a Mini-Course Project for designing a processor data path. The instructor and lab supervisor sets up the design specifications with enough generality to enable more than one solution. The course outcome (c) will be covered by rating the Engineering Design Aspects in the above project. The rating will be individualized for each student team. The final report submitted by students is assessed based on ABET attributes of Outcome 'C".	Student project reports with grading sheets.	In most cases, we notice the following observations (See filled Rubrics) where rating the above attributes: 1. Mostly Requirements are translated into specifications. There is no clear description of the translation of requirements into specifications but implicitly addressed. 2. Critical problems are excellently well formulated at all levels of the design and properly analyzed. Enough test cases are provided, logical, arithmetic, L/S and Branch instructions,	1. **Good technical level**: The average assessment rating is 3.21/4 which is much higher than the departmental target score (2.5/4). **This is an indication that the students have the technical level for handling the project.** 2. **Less structuring in the Lab**: The student work is too structured due to the above 5 supervised labs, i.e., a total of 15 hours of supervised and guided design. Because of the above structured lab project, the work by different team is alike and many engineering

					Forwarding, least stall pipeline, and TESTING all of the above. 3. Different design alternatives are implicit: ALU, Register File, Updating PC, Forwarding, Stall Cycles, etc. 4. No systematic analysis of constraints but the proposed solution results from some acceptable cost minimization 5. The approach used excellently breaks down the design into single cycle datapath, identify needed components, place inter-stage buffers with some contents, implement forwarding, etc.	fundamental are only indirectly addressed but not reported. The lab should be organized in a way to provide an environment for developing student experience to show the strength and weaknesses of their ability to carry out an engineering design project including their ability to learn on their own through the use of some design tools. 3. **Spread the Culture of Engineering COE Curricula**: Progressively inject engineering design methodology in every lab activity in the COE program and present a comprehensive E.D. methodology (integrating all aspects) in COE 300 Principles of Computer Engineering Design.
COE 405	**11**	**76% & 3.30/4**	Outcome C has been assessed in this course using different methods	Midterm & Final Exams	Based on the exam-based average score for all students (**76%**) and	While this course covers the design of digital systems, it also covers

			including homework, exams and projects. However, the following exam questions were used as a direct assessment measure as all homework and projects were based on groups of two students and may not reflect accurately individual student ability in this outcome. **i. Midterm Exam: Q1, Q3 and Q4** **ii. Final Exam: Q2 and Q3** In addition, Outcome C rubric will be filled based on the performance of students in the two course projects and their overall performance in the course.	Course Projects	the rubric assessment, it is considered that the achievement of this outcome is considered **satisfactory**. However, it is observed that two students have poor performance in the achievement of this outcome while two students have fair performance. The remaining 7 students have done quite well. This is consistent with the indirect assessment conducted through a survey in which 7 students thought that their ability in designing digital systems is considered excellent. Three students thought that their design ability is considered good and one student thought that his design ability is considered average.	modeling digital systems using Verilog, the use of tools for design simulation and FPGA boards for implementing the design and verifying its correct functionality. In order to improve the achievement of Outcome C related to design, more design examples will be added to lecture slides and covered in class. In addition, at least one of the course projects will be formulated to emphasize design aspects such as exploring alternative solutions and meeting design constraints.
COE 444	**10**	**2.94/4**	The project is used for the assessment of Outcome C in COE 444. The project is about the design of a network (including	Project Final Reports	• The average score of all areas for this outcome is 2.94 out of 4 (>2.5), which is in alignment with the	• The design alternatives area should be improved. The existing project guidelines given to

			requirement analysis, logical design, and physical design phases) that satisfies requirements provided to students as a Request for Proposal (RFP) document. This assessment is done for each team of three or four students, but not for individual students. A standard rubric used by COE for assessing Outcome C has been used to assess the project's final report of each team. For each team, a rubric has been filled that assigns a score for each outcome area and cites the pages in the report that were used to assess a particular area. These filled rubrics are included in the course file of this course. An Excel sheet of the detailed scores for individual students on each outcome area is included in the course file of the course.		score of 4 out of 5 obtained from the students survey for outcome C. • The design alternatives area is getting a score of 2.3 which is lower than 2.5. And therefore, this area needs improvement. • All other outcome areas achieved scores higher than 2.5, which are acceptable.	students had a statement requesting from each team to include design alternatives in their final report. However, not all of them did, and some did not do it appropriately. • One corrective action is to dedicate part of a class to explain what is meant by design alternatives and discuss it with the students through few examples. • Another corrective action is to assign a network design problem with limited scope to the students and have them present in the class their proposed design. Then, we can have a discussion in the class about the different alternatives for designing this network.

COE 485	**5**	**2.64/4**	COE 485 (Senior Design Project) is a capstone course in which senior students work in teams to realize a practical engineering solution. By the end of the semester, students are evaluated based on their projects' deliverables; namely final reports and final presentations/demos. Outcome C concerns the ability to design a system, process, or component to meet desired needs subject to given constraints. It also concerns the ability to analyze and evaluate alternative solutions. This outcome is assessed based on the students' final presentation and project report using the Outcome C rubric. For every project, the rubrics are filled by the project's adviser and two faculty examiners. Students are provided with the final report template (enclosed). The template is	• Two final project reports marked /graded by the correspondi ng project's adviser. • Two demo videos for the two projects • Filled evaluation forms for two projects (3 forms per project) • Filled rubrics for outcome C (3 per project) • Excel sheets with detailed scores for rubrics of Outcome C	**Elrabaa:** Students still start from the end; i.e. they get final concept for the project in their minds somehow, and then work backward trying to justify the choices they made, hence they end up with what they had in mind in the 1st place. This prevents them from exercising the real powers of engineering design and inhibits their creativity. Also, evaluation of different design options is mostly not based on verifiable criteria. **El-Maleh:** The students have done well in the design process where they have started from an open source design and considered adding features that exist in commercial products. They have followed a structured design methodology, considered alternative solutions, considered and met both technical and economical	**Elrabaa:** • There must be a template for the project proposal to ensure that the given project do not have a very obvious implementation. • Coordinators must figure out a way to make the students meet weekly with their project advisors **El-Maleh:** • Weekly meetings between the students and advisor are essential as the advisor should guide the students and provide them with timely feedback to help them in the design process. **Khayyat:** • Monitor, and enforce if required, regular advisor supervision • Periodic evaluation of progress prepared by the advisor and reviewed by the coordinator in order

			used to assess all the Outcome C rubric clauses.	• Announcement email for the final presentation • Final report template	constraints, met design requirements by manufacturers, designed their own PCB board, selected and sourced needed components and managed to have a working product by the end of the semester. In my opinion, the students have done a challenging and outstanding work. **Khayyat:** • Independent student work without frequent advisor consultations may result in a non-satisfactory project. In particular, it could result in: ○ Changing the project requirements ○ Not following a rigorous design workflow, and making arbitrary decisions instead ○ Over-simplifying the project (or potentially over-	to identify any mis-behavior before it's too late, and rectify it • Train the students to ○ Start by looking for existing solutions to justify their effort by demonstrating its novelty and motivation ○ Be able and willing to start with an existing solution and extend it, instead of starting from scratch (this would contribute to Outcome L as well) ○ Consider multiple options and document design decisions appropriately • Require sufficient technical documentation to guarantee reproducibility • Host project outcomes (software/documentation

					complicating it) ○ Falling back to familiar practices instead of innovation and exploration of new ones • Students tend to stick to what they have been exposed to before. Instead, they should be trained to explore new options and evaluate them objectively to justify their decisions • Projects lack sufficient documentation to guarantee reproducibility. This results in wasted efforts, and prevents future projects from building upon previous ones. **Almulhem:** Introducing the final report template this term seems to help students producing better documentations of their projects.	/prototypes) such that they are accessible to newer students so they can extend previous efforts to produce something more significant. **Almulhem:** • There is a need to develop a project proposal template to help screening projects • There should be a repository of project proposals coming from faculty members. The repository should be made public for the students to browse and choose from.

Total	**34**	**3.08**	*** Summarized as is from course instructor's reports**
		Weighted Average	

2. Comments:
Your overall Comments on Outcome Achievement, Weaknesses in certain outcome aspects, Weaknesses in certain courses, … **Score > 2.5: Achieved (A), Score: ≈ 2.5: Marginally Achieved (M), Score < 2.5: Need Improvement (NI)**
Outcome C (the ability to design a system, process, or component to meet desired needs subject to given constraints) was achieved in all 4 courses, i.e., COE 301, COE 405, COE 444, and COE 485. **Introducing the final report template this term for COE 485 seems to help students producing better documentations of their projects.** **However, the design alternatives area in COE 444 is getting a score of 2.3 which is lower than 2.5. It was also observed in COE 485 that the evaluation of different design options is mostly not based on verifiable criteria. And therefore, this area needs improvement.** **It is also observed from COE 485 that:** - **There is limited exercising of engineering design and creativity. Students also tend to stick to what they have been exposed to before.** - **Independent student work without frequent advisor consultations may result in a non-satisfactory project.** - **Projects lack sufficient documentation to guarantee reproducibility**

3. Corrective Actions:
List specific suggested corrective actions ranked in order of importance, practicality, and potential impact (bullet points)
For COE 485: - **There should be a repository of project proposals coming from faculty members. The repository should be made public for the students to browse and choose from.**

- **There must be a template for the project proposal to help screening projects and to ensure that the given project do not have a very obvious implementation.**
- **Coordinators must figure out a way to make the students meet weekly with their project advisors. Weekly meetings between the students and advisor are essential as the advisor should guide the students and provide them with timely feedback to help them in the design process.**
- **Periodic evaluation of progress prepared by the advisor and reviewed by the coordinator is needed in order to identify any mis-behavior before it's too late, and rectify it.**
- **Require sufficient technical documentation to guarantee reproducibility**
- **Host project outcomes (software/documentation/prototypes) such that they are accessible to newer students so they can extend previous efforts to produce something more significant.**
- **Train the students to:**
    - **Start by looking for existing solutions to justify their effort by demonstrating its novelty and motivation**
    - **Be able and willing to start with an existing solution and extend it, instead of starting from scratch (this would contribute to Outcome L as well)**
    - **Consider multiple options and document design decisions appropriately**

For COE 301:

- **Less structuring in the Lab: Because of the use of a structured lab project, the work by different team is alike and many engineering fundamental are only indirectly addressed but not reported. The lab should be organized in a way to provide an environment for developing student experience to show the strength and weaknesses of their ability to carry out an engineering design project including their ability to learn on their own through the use of some design tools.**

- **Spread the Culture of Engineering COE Curricula: Progressively inject engineering design methodology in every lab activity in the COE program and present a comprehensive E.D. methodology (integrating all aspects) in COE 300 Principles of Computer Engineering Design.**

For COE 405, more design examples will be added to lecture slides and covered in class. In addition, at least one of the course projects will be formulated to emphasize design aspects such as exploring alternative solutions and meeting design constraints.

For COE 444, the design alternatives area should be improved. One corrective action is to dedicate part of a class to explain what is meant by design alternatives and discuss it with the students through few examples. Another corrective action is to assign a network design problem with limited scope to the students and have them present in the class their proposed design. Then, there can be a discussion in

the class about the different alternatives for designing this network.

Report for Student Outcome f

Outcome Assessment Report	**(Covers 3 Courses)**		
Outcome	**F**	**Semester**	**131**
Prepared by:	**Dr. Muhammad Elrabaa**	**Date:**	**12/1/2014**

1. Summary of Course Reports:

Course	Number of Students	Average Outcome Score	Assessment Method*	Evidence Provided	Comments*	Proposed Corrective Actions*
COE 351	**5**	**3.2**	Indirect (no way to really observe this outcome): Progress & Final reports	Reports	The reason for the higher assessment score for the COOP students could be due to the fact that the COOP students are exposed to the work environment for a longer period of time (28 weeks) than the summer training students (8 weeks).	• Inject subjects related to professional ethics in COE 300 and make COE 300 a prerequisite to both COOP (COE 351) and summer training (COE 399). • Request from the Deanship of Student Affairs the inclusion of an evaluation item related to professional ethics in the Evaluation Forms that are used
COE 399	**4**	**2.75**				

						by the companies hosting the COOP and the summer training students for evaluation of the hosted students.
COE 300	**10**	**2.15**	Direct through an exercise.	Students responses to the exercise	Clear lack of understanding of ethical & professional responsibilities --	Need to give extra lectures on ethical issues and their effects on the profession. Students need to be taught why are good for business! This need to be done in several courses, including labs to have significant effect on the students.
Total	**19**	**2.50**	*** Summarized as is from course instructor's reports**			
		Weighted Average				

2. Comments:
Your overall Comments on Outcome Achievement, Weaknesses in certain outcome aspects, Weaknesses in certain courses, … **Score > 2.5: Achieved (A), Score: ≈ 2.5: Marginally Achieved (M), Score < 2.5: Need Improvement (NI)**
- **This outcome is far from being achieved,** - **The results from COE 351 and COE 399 are completely unrealistic; assessors did not have any platform to observe the students' understanding of their professional and ethical responsibilities other than the companies' reports where they state if the student has been coming to work on time or not! That is hardly enough to make any statement about this outcome,** - **Assessment in COE 300 showed that students believe that ethical conduct is not part of the responsibilities of a professional engineer, but rather something they would do out of their 'good' nature or beliefs – They did not know that extent of their professional responsibilities toward their customers.**

3. Corrective Actions:
List specific suggested corrective actions ranked in order of importance, practicality, and potential impact (bullet points)

- **COE 351 & COE 399 need to have real assessable components that demonstrate the students' understanding of their professional and ethical responsibilities. Otherwise, these courses can't be used to assess Student Outcome F,**

- **Students should be given more lectures on professional & ethical responsibilities of computer engineers. They also need to be taught the negative impact of unprofessional and unethical conduct, on their person, employers and the whole society.**

Report for Student Outcome g-W

Outcome Assessment Report	(Covers 2 Courses)		
Outcome	**G (Written)**	**Semester**	**131**

Prepared by:	Ahmad Khayyat	Date:	26/1/2014

1. Summary of Course Reports:

Course	Number of Students	Average Outcome Score	Assessment Method*	Evidence Provided	Comments*	Proposed Corrective Actions*
COE 351	5	2.10	advisor and examiners fill out a rubrics form for outcome G(W) for each student based on progress reports, final reports, and company reports	Rubrics based on progress, final, and company reports	The reason for the higher assessment score for the summer training students could be due to the fact that the summer training students have more focused tasks to be accomplished over a shorter period of time (8 weeks) than the COOP students (28 weeks). This may result in a more efficient writing as observed through the progress and the final reports.	• Provide the students with a streamlined report template to be used for reporting. • Revisit some of the rubrics clauses that may not be highly pertinent to the typical tasks of the COE COOP/summer training students such as "Formulae and equations" and "Quality Engineering Documentation." Also, expand the available score options for such clauses to include "N/A" so that these clauses will be ignored from the computation of the average assessment score.
COE 399	10	2.37				
Total	**15**	**2.28**	*** Summarized as is from course instructor's reports**			
		Weighted Average				

2. Comments:
Your overall Comments on Outcome Achievement, Weaknesses in certain outcome aspects, Weaknesses in certain courses, … **Score > 2.5: Achieved (A), Score: ≈ 2.5: Marginally Achieved (M), Score < 2.5: Need Improvement (NI)**
The outcome needs quite a bit of improvement.

3. Corrective Actions:
List specific suggested corrective actions ranked in order of importance, practicality, and potential impact (bullet points)
• Request the help of the English Department, and ask them to revise English courses to better prepare students for technical writing. • Evaluate and provide feedback on the writing aspects of reports prepared by students throughout the program, e.g. course project reports.

Report for Student Outcome g-O

Outcome Assessment Report	(Covers 2 Courses)		
Outcome	**G (Oral)**	**Semester**	**131**

Prepared by:	Ahmad Khayyat	Date:	26/1/2014

1. Summary of Course Reports:

Course	Number of Students	Average Outcome Score	Assessment Method*	Evidence Provided	Comments*	Proposed Corrective Actions*
COE 351	5	2.90	Advisor and examiners fill out a rubrics form for outcome G(O) for each student based on public presentations	Rubrics based on presentations	The reason for the higher assessment score for the COOP students could be due to the fact that the COOP students have more chances to present their work to the their managers and co-workers in the work environment over a longer period of time (28 weeks) than the summer training students (8 weeks)	• Request from companies that students must present their work at the end of the COOP/summer training term to their managers and co-workers. • Request from the Deanship of Student Affairs the inclusion of an evaluation item related to oral communication in the Evaluation Forms that are used by the companies.
COE 399	10	2.49				
Total	15	2.63	* Summarized as is from course instructor's reports			
		Weighted Average				

2. Comments:

Your overall Comments on Outcome Achievement, Weaknesses in certain outcome aspects, Weaknesses in certain courses, … **Score > 2.5: Achieved (A), Score: ≈ 2.5: Marginally Achieved (M), Score < 2.5: Need Improvement (NI)**
Outcome is achieved with a small margin.

3. Corrective Actions:
List specific suggested corrective actions ranked in order of importance, practicality, and potential impact (bullet points)
Require additional oral presentations from students throughout the program in multiple courses. Many courses already involve projects with reports. Having students present their effort helps them develop and practice their presentation skills. It is also important to provide feedback to students on overall presentation delivery rather than limiting feedback to technical content.

Report for Student Outcome h

Outcome Assessment Report	(Covers 2 Courses)		
Outcome	**H**	**Semester**	**131**
Prepared by:	**Dr. Muhammad Elrabaa**	**Date:**	**12/1/2014**

1. Summary of Course Reports:

Course	Number of Students	Average Outcome Score	Assessment Method*	Evidence Provided	Comments*	Proposed Corrective Actions*
COE 485	**5**	**2.33**	Direct from final report, where students wrote a section on the impact of their project	Final Reports	- Students showed little understanding of local social/economic impact of their project. In addition, they lacked any global perspective, - Limited student awareness and appreciation of the impact of their project on their environment - Discussion of the impact of the project is minimal, and appears to be aimed at fulfilling the provided report template only - Introducing the final report template this term seems to help students producing better documentations of their projects, - Some students have recognized the recent interest in their project and its impact	- Students must meet with their supervisors regularly to discuss the impact of their work, - This outcome needs to be well explained to the students and students should discuss with their advisor the impact of their solution, - This outcome is hard to achieve through a single course. It should be injected throughout the curriculum and in all courses, - Faculty should consider commenting on such issues whenever an opportunity presents itself in any course to reinforce the sense of impacting the environment through engineering solutions, - Students should demonstrate their consideration of the impact of various design options when presenting/documenting their

					on a specific technology.	project's design decision process, - Students should be made aware that economic impact is especially relevant to almost all decisions, - There is a need to develop a project proposal template to help screening projects - There should be a repository of project proposals coming from faculty members. The repository should be made public for the students to browse and choose from.
COE 300	**10**	**2.64**			A significant portion of the students lack any view of the potential global impact of their solution.	- The culture of recognizing global issues and opportunities has to be injected early on in the course, - Also, students have to be asked specifically about this aspect of their project; how could it be deployed globally
Total	**19**	**2.53**	*** Summarized as is from course instructor's reports**			
		Weighted Average				

2. Comments:
Your overall Comments on Outcome Achievement, Weaknesses in certain outcome aspects, Weaknesses in certain courses, … **Score > 2.5: Achieved (A), Score: ≈ 2.5: Marginally Achieved (M), Score < 2.5: Need Improvement (NI)**
- **This outcome is barely achieved,** - **The results from COE 485 were much worse. This is because almost all of these students are from the old curriculum, where impact of engineering solutions was not discussed. The introduction of COE 300 in the new curriculum will improve the situation, but as observed and suggested by the assessment, that might not be enough.**

3. Corrective Actions:
List specific suggested corrective actions ranked in order of importance, practicality, and potential impact (bullet points)
- **Impact of engineering solutions should be injected in most courses,** - **Students must be asked to project the socio-economic impact of their solutions,** - **Regular meetings with project supervisors is a must,** - **There is a need to develop a project proposal template to help screening projects to identify projects that have potential impact from those that do not.**

Report for Student Outcome J

Outcome Assessment Report	(Covers 2 Courses)		
Outcome	**J**	**Semester**	**131**
Prepared by:	**Dr. Muhammad Elrabaa**	**Date:**	**12/1/2014**

1. Summary of Course Reports:

Course	Number of Students	Average Outcome Score	Assessment Method*	Evidence Provided	Comments*	Proposed Corrective Actions*
COE 485	**5**	**2.00**	Direct from final reports, Demos, and presentations	Reports	- Students did not allude to the contemporary issue their project is supposed to deal with at all, - Some recognition of the potential impact of their projects on technology and our lives - Introducing the final report template this term seems to help students producing better documentations of their projects	- There is a need to develop a project proposal template to help screening projects, - There should be a public repository of project proposals coming from faculty members for the students to browse and choose from, - This outcome needs to be well explained to the students and should be discussed by the advisor, - Students should regularly meet with their supervisors to explain these issues to them, - Exposure to contemporary issues in English/Arabic writing courses would broaden their perspectives

						and make them aware of many of the contemporary issue of our time, - This outcome is hard to achieve through a single course. It should be injected throughout the curriculum and in all courses, - Faculty should consider commenting on such issues whenever an opportunity presents itself in any course to reinforce the role of engineers in tackling various contemporary issues, - Students should include relevant motivation for choosing their project. A more significant / relevant project should be rewarded as such
COE 300	**10**	**2.59**	Direct from a presentation	Students presentation slides	- A significant portion of the students lack any global view of world issues	- The culture of recognizing global issues has to be injected in English courses where students routinely write essays on various subjects. Instructors can assign global contemporary issues (related to Environment, Health Care, Water, Energy …etc) for students to search, obtain data and write about

Total	**19**	**2.40**	*** Summarized as is from course instructor's reports**
		Weighted Average	

2. Comments:
Your overall Comments on Outcome Achievement, Weaknesses in certain outcome aspects, Weaknesses in certain courses, … **Score > 2.5: Achieved (A), Score: ≈ 2.5: Marginally Achieved (M), Score < 2.5: Need Improvement (NI)**
- **This outcome is far from being achieved,** - **The results from COE 485 were much worse. This is because almost all of these students are from the old curriculum, where Contemporary issues and their relation to Computer Engineering were not discussed. The introduction of COE 300 in the new curriculum will improve the situation, but as observed and suggested by the assessment, that might not be enough.**

3. Corrective Actions:
List specific suggested corrective actions ranked in order of importance, practicality, and potential impact (bullet points)
- **The culture of recognizing global issues has to be injected in English/Arabic courses where students routinely write essays,** - **Faculty should consider commenting on such issues whenever an opportunity presents itself in any course to reinforce the role of engineers in tackling various contemporary issues. Also, senior project supervisors should explain this outcome to the students and discuss how their project relates to it,** - **There is a need to develop a project proposal template to help screening projects to identify projects that relate to contemporary issue from those that do not,**

Report for Student Outcome L

Outcome Assessment Report	(Contains 3 Sections)		
Outcome	**L**	**Semester**	**131**

Prepared by:	**Muhamed Mudawar**	**Date:**	**January 13, 2014**

1. Summary of Course Reports:

Course	Number of Students	Average Outcome Score	Assessment Method*	Evidence Provided	Comments*	Proposed Corrective Actions*
COE 306	**9**	**3.45**	Midterm and Final exams, quiz, project, and Lab.	Second major exam, Final exam, Quiz4, project, and Lab component. Rubrics for outcome L	**Raad**: For assessing the selection of hardware and software for the project, I used the lab component (20%). In the second major exam, the first question was designed to assess the capability of students to interface between the ARM processor and various kinds of memories using the AMBA bus. The second question was about designing the automotive seat belt alarm embedded system. In the final exam, Question 1 was based on an industrial	**Raad**: The lab was based on ARDUINO microcontroller. It did not go in line with the course. In the integration process of hardware and software, students lacked the vision or plan in their design during the project development cycle. I highly recommend that both lab and course should go in line using the same platform and that the project should be discussed in class as part of the course requirement.

					application of smart fridge where a sensor network monitors out of stock beverages.	
COE 351	**5**	**2.50**	Progress reports, Final reports, Power point presentations	Rubrics for outcome L	**Abu-Amara**: The reason for this average score (2.50) is the variations of the different tasks provided to the COOP students by the different companies. Some companies hosting the COOP students lack projects and tasks that require the integration between hardware and software.	**Abu-Amara:** Encourage the COOP students to sign up with companies that provide projects and tasks that require the integration of hardware and software whenever possible. Can be achieved by: 1. Early screening of the companies and ranking them accordingly. 2. Building a history about the companies and their ability to provide projects and tasks that require the integration of hardware and software.
COE 485	**5**	**2.80**	Students Final presentations and project reports For every project, the rubrics are filled by the	Two final project reports marked /graded by the corresponding project's adviser. Two demo videos for the	**Elrabaa:** The students had very little integration in their project. **El-Maleh**: The students have done excellent work integrating two microcontrollers Atmega 2560 and Atmega 325 and CC3000 Wifi module from Texas instruments in addition	**Elrabaa:** Projects offered must require integration of standard/custom components, Regular meetings with project supervisors would help a lot **El-Maleh:** Senior projects need to be planned for a

			project's adviser and two other faculty examiners	two projects Evaluation forms for two projects (3 forms per project) Rubrics for outcome L (3 per project) Excel sheets with detailed scores for outcome L. Announcement email for the final presentation Final report template	to many other components. They have designed their own board integrating all the components. They have also considered and evaluated several microcontrollers and 3D printer frame options. **Khayyat:** Projects exhibited little integration of existing components/solutions. **Almulhem:** Introducing the final report template this term seems to help students producing better documentations of their projects.	semester before their offering. This will allow enough time for ordering necessary components as one semester is challenging task to order components and complete the project on time. **Khayyat:** Train the students to start where the others have left off, and reuse and extend existing solutions Propose more sophisticated projects that require the use of existing solutions as components in order to be completed within the required time frame. Require or emphasize modularity and the documentation of interfaces, even in case the entire system is built by the students. For instance, if multiple existing solutions can be used as alternatives to provide a certain function, perhaps the students should accommodate both through a unified interface.

						Almulhem: There is a need to develop a project proposal template to help screening projects There should be a repository of project proposals coming from faculty members. The repository should be made public for the students to browse and choose from.
Total	**19**	**3.03** **Weighted Average**	*** Summarized as is from course instructor's reports**			

2. Comments:

Your overall Comments on Outcome Achievement, Weaknesses in certain outcome aspects, Weaknesses in certain courses, …
Score > 2.5: Achieved (A), Score: ≈ 2.5: Marginally Achieved (M), Score < 2.5: Need Improvement (NI)

Outcome L (Integration of Hardware and Software) was achieved in COE 306 and COE 485. However, it was marginally achieved in COE 351. The main reason for this marginal score in COE 351 (COOP) is the lack of companies that host our COOP students and require the integration of hardware and software. Many COOP projects are software-oriented and do not map to outcome L. The screening of companies might address this problem, but cannot resolve it completely. Therefore, the assessment of outcome L should apply only to COOP projects that do the integration of hardware and software.

It was also noticed that some senior design projects (COE 485) do little integration of hardware and software. These comments were raised by project advisors, examiners, and the coordinator.

3. Corrective Actions:

List specific suggested corrective actions ranked in order of importance, practicality, and potential impact (bullet points)
For COE 306 (Introduction to Embedded Systems), it is recommended to have both the lab and course go in line using the same platform and that the project should be discussed in class as part of the course requirement. There is also a need to improve the lab component, and to switch to the ARM Cortex-M family boards. **The requirement of outcome L should be made clear to COOP (COE 351) and Senior Design Project (COE 485) students. Regular meetings with the project supervisor will help improve these projects. Training students to take advantage of older projects, granting access, and extending these projects. The use of existing solutions as components. Emphasizing modularity and the documentation of interfaces.** **Planning Senior Design Projects one semester in advance before their offering. Ordering components in advance and ensuring that projects complete on time.**