King Fahd University of Petroleum and Minerals

Computer Engineering Department

SELF-ASSESSMENT FOR ACCREDITING THE COMPUTER ENGINEERING PROGRAM

CONTENTS

Program Educational Objectives (PEOs)

- KFUPM vision

  To be a vibrant multicultural University of international repute focuses on quality education and innovative research that prepares professionals and entrepreneurs to lead social, economic and technical development in the region.

- CCSE main objectives:
  - To provide the skilled manpower needed for the fulfillment of the country's development plans. In particular: information & computer scientists, computer engineers, and systems engineers.
  - To prepare students for graduate work and research in their field of specialization.
  - To provide a link through which computer technologies and their applications could be transferred to the country.
  - To provide the country, through research and graduate studies, with skills, ideas, and innovations in certain areas of advanced technologies.

Program Educational Objectives (PEOs)

- The objectives of the COE program

  To produce computer engineering graduates prepared to:

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

Program Outcomes (POs)

- (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

Program Outcomes (Cont)

- (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 will change, coupled with enhancing their self-learning ability.

Program Outcomes (Cont)

- (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.

Department specific:

- (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

Mapping of POs to PEOs

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

Consulting the Constituents

- The COE Faculty
- The COE Students
- Industry Advisory board
- Alumni
- Employers

Approval by the Constituents

- The program constituents approved the PEOs and the POs:
  - Faculty council resolution (documented)
  - Advisory board meeting (documented)
  - Surveyed: Alumni, Employers, Coop supervisors, and students.
- The PEOs and the POs are now published on the COE Departmental Web Page.

Mapping of Course Outcomes to POs

	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	L	H	L	H				L		L			
COE 308	H		H		L				L		L			
COE 341	M		H		H				L		L			
COE 344	M	L			H					L	L			
COE 360	L	L	H	L			L				M			
COE 390						M	H	L	M	M				
COE 400	M	M	L	M	L	L	M	L	L	L	L			H
COE 485	L	M	H	M	L	L	M	L	L	L	M			
COE 351			H	M		M	H		M		M			
COE 399				M		M	H		M		H			
STAT 319												H		
ICS 252													H	
IAS 211						H								
ENGL 214							H							

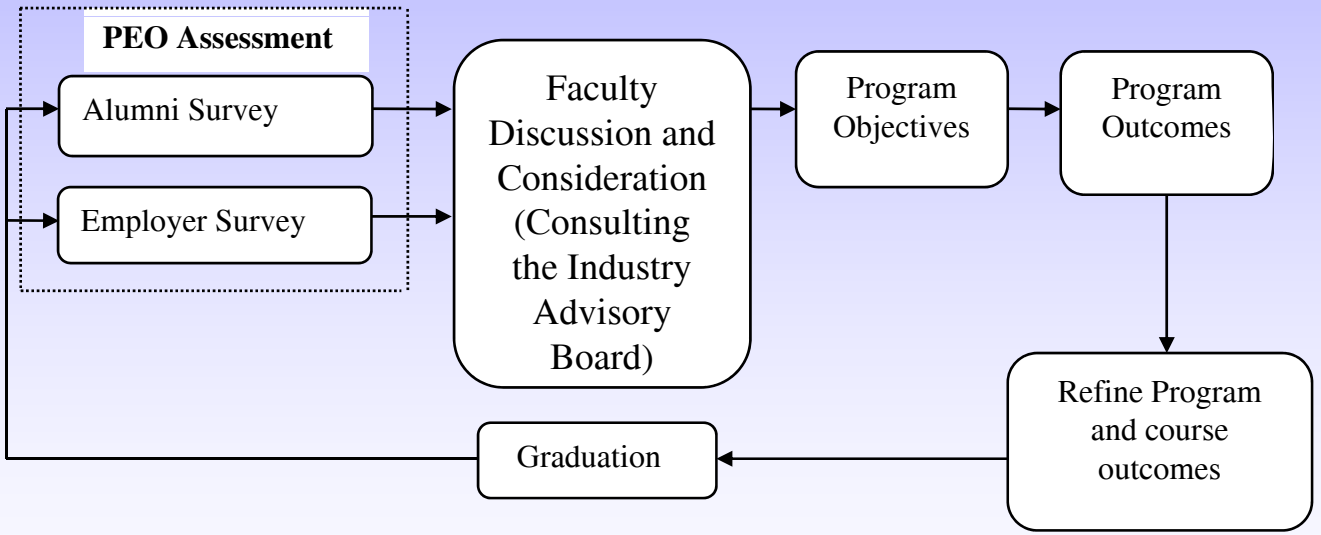
Performance Indicators

Program Outcome (Performance Indicators)	Assessment & Evaluation Methods	Performance Criteria	Logistics
(a) an ability to apply knowledge of mathematics, science, and engineering: 1. apply math and Boolean algebra in number systems and simplification of Boolean algebraic expressions. 2. apply knowledge of mathematics, probability, and engineering in processor design. 3. apply knowledge of mathematics, probability, and statistics to model and analyze some networking protocols. 4. apply knowledge of mathematics, science and Engineering in design and analysis of different alternative implementations of a system's specification.	• Samples of COE 400, COE 485 and COE 351 reports • Math 101, Math 102, Math 201, Math 260, Phys. 101, Phys. 102, chem.. 101 • Exit exam • Graduate Exit Survey • Coop Employer Survey	• A score ≥ 2.5 out of 4 • Average GPA ≥ 2.5 out of 4 • A score ≥ 60% • A score ≥ 3 out of 5 • A score ≥ 3 out of 5	Assessments will be Conducted as per COE Assessment Plan. However, grades of Math, Phys. & Chem. Courses will be collected and analyzed once a year.
(b) an ability to design and conduct experiments, as well as to analyze and interpret data	• Samples of COE 400, COE 344 and COE 305 lab reports • 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 as per COE Assessment Plan.

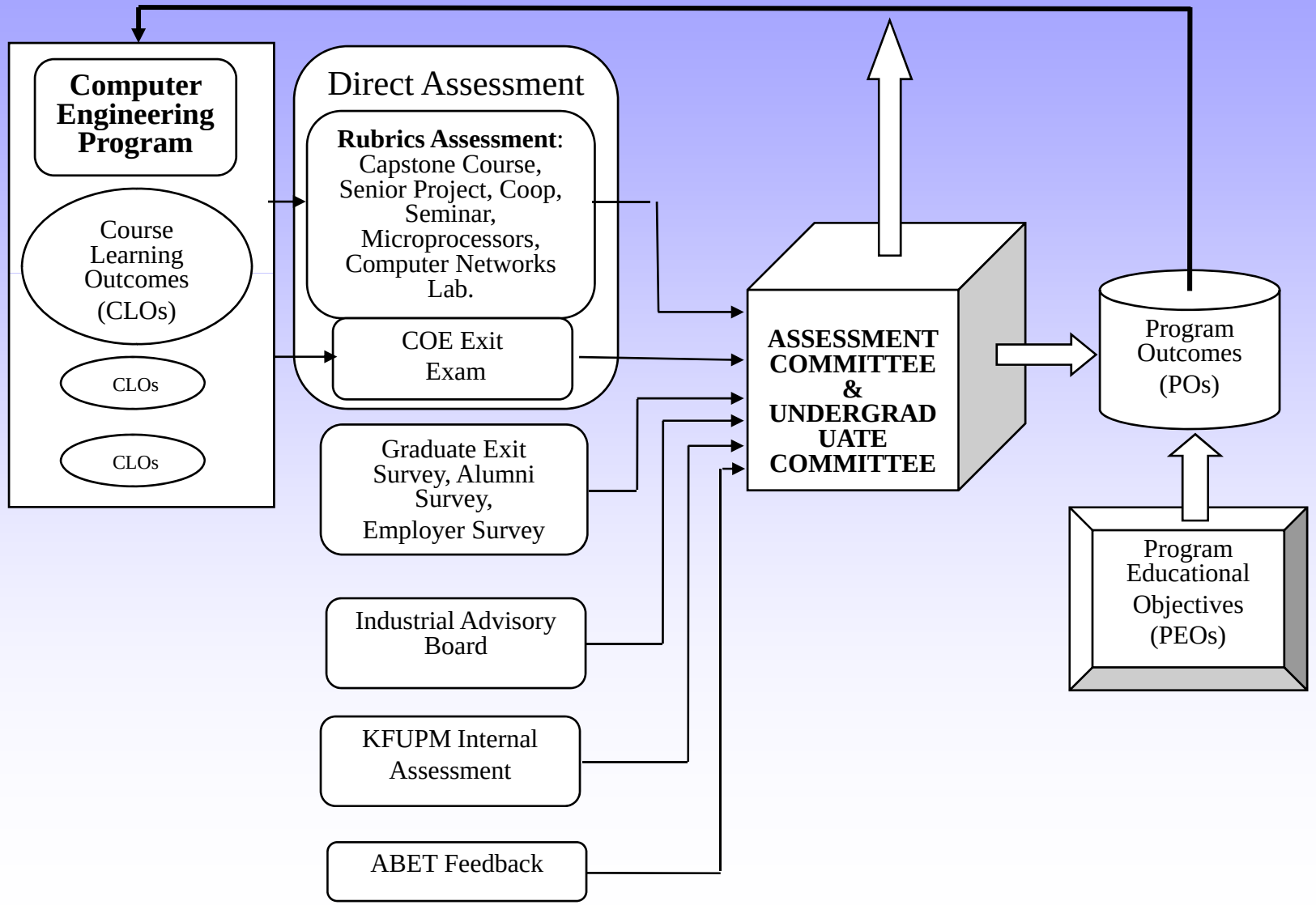
Performance Indicators

Program Outcome (Performance Indicators)	Assessment & Evaluation Methods	Performance Criteria	Logistics
(c) an ability to design a system, component, or process to meet desired needs: 1. Design combinational and sequential logic circuit and MOS circuits 2. analyze, design, implement, and test assembly language programs. 3. design, debug and test a embedded system 4. design the datapath and control of a processor 5. analyze and design communication systems, processes, and components.	Samples of COE 400, COE 485 and COE 351 reports 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 as per COE Assessment Plan. .
(d) an ability to function on multi-disciplinary teams	Samples of COE 400, COE 485 and COE 351 reports Peer & instructor evaluations in COE 400 Graduate 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 as per COE Assessment Plan. .

Assessment Approach and Tools: PEOs Review



Assessment Approach and Tools: POs Assessment



Assessment Approach and Tools: Assessment Method

- **Direct Assessment**
  - Rubrics
    - Microcomputer System Design (COE 305) lab (outcome b)
    - Computer Networks lab (COE 344) lab (outcome b)
    - Cooperative Work (COE 350/351) (outcomes a, c, d, e, g, h, i, j, k, and n)
    - Seminar (COE 390) (outcome f)
    - Summer Training (COE 399) (outcome g)
    - System Design Laboratory (COE 400) (outcomes (a, b, c, d, e, g, h, i, j, k, n)
    - Senior Design Project (COE 485) (outcomes a, c, d, e, g, h, i, j, k, and n)
  - Computer Engineering Exit Exam
  - Course Assessment (internal)
    - All COE core courses
- **Indirect Assessment**
  - Industrial Advisory Board
  - Employer Survey
  - Alumni Survey
  - Graduate Exit Survey
  - Student Survey (course)

Assessment Approach and Tools: Program Outcomes Assessment Process

- Two committees to conduct assessment process: The Assessment Committee (AC) and the Undergraduate Committee (UC).

- Assessment committee responsible of
  - design and control of the direct and indirect assessment processes,
  - data collection and presentation,
  - data delivery to undergraduate committee.

- Undergraduate Committee responsible of
  - Carrying out analysis of direct and indirect assessment data provided by the Assessment Committee and the Faculty based on course assessment results.
  - identify potential problems and suggest recommendations for making improvements.
  - Implementing approved recommendations.

Assessment Approach and Tools: How Rubrics are used in COE

Course	Rubrics to be Used for Outcome											
	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*n*
COE 305		×										
COE 344		×										
COE 351	×		×	×	×		×	×	×	×	×	×
COE 390						×						
COE 399							×					
COE 400	×	×	×	×	×		×	×	×	×	×	×
COE 485	×		×	×	×		×	×	×	×	×	×

1) Note the following:

i. COE 399 is used for COE program assessment through "Rubrics" only once a year (i.e. in the 1st term)

ii. All other courses are used for COE program assessment through "Rubrics" twice a year (i.e. in the 1st and the 2nd terms)

Assessment Approach and Tools: Oral Presentation Rubrics (Sample)

ORAL PRESENTATION ASSESSMENT

Presenter's Name: _____ Presenter ID#: _____
Presentation Title: _____
Evaluator's Name: _____ Date: _____

Outcome	Novice (1)	Apprentice (2)	Proficient (3)	Exemplary (4)	Score	Comments
•**Audience awareness** (interacts with audience: e.g. stepping toward audience and speaking to them, not at them), looking at them, making eye contact	Does not interact with audience at all … Does not look at the audience … Look at PC, screen, or elsewhere	Little interaction with audience … Most of the time looks elsewhere	Some interaction with audience	Interacts with audience throughout presentation		
•**Focus**: goal, evidence, conclusion (gives audience a roadmap and follows it)	Does not give audience an adequate road map of goal, evidence and conclusion	Gives audience some road map of goal, evidence and conclusion	Gives audience an adequate road map of goal, evidence and conclusion	Gives audience very clear road map of goal, evidence and conclusion		
•**Transitions** (phrases smoothly link one part to next)	Abruptly transitions from one phase to the next … No linking	Some transition is provided though not smooth	Transitions are generally smooth	Very smooth Transitions		
•**Use of visual aids (any non-plain text methods such as graphs, charts, flow diagrams …etc.)** to tell the story and enhance the quality of the presentation	Either does not use visual aids at all; or too much dependency on visual aids	There is some use visual aids effectively to tell the story	Overall, uses visual aids effectively to tell the story; visual aids add to presentation	Uses visual aids very effectively to tell the story; visual aids enhance presentation		

Assessment Approach and Tools: Oral Presentation Rubrics (Sample)

Mechanics	Novice (1)	Apprentice (2)	Proficient (3)	Exemplary (4)	Score	Comments
•**Body position** (e.g., facing audience or screen)	Body position (faces screen or board all the time)	Body position (faces audience some of the time)	Body position (faces audience most of the time)	Body position (always facing audience)		
•**Eye contact**: (e.g., scanning entire audience)	No eye contact	Some eye contact (not enough, looking down a lot)	Eye contact (some scanning of audience, looking at people)	Eye contact (excellent scanning of audience, looking at people)		
•**Visual aids** (e.g., clear, not too busy, readable size font)	Visual Aids (too busy, blurry)	Visual Aids (a little bit busy, sometimes not clear)	Visual Aids (can read clearly, usually not too much material)	Visual Aids (clear, right amount on each slide)		
•**Delivery** (e.g., fluency, pace, voice projection, um's, uh's)	Delivery (too fast, too many um's, not projecting voice, lack of enthusiasm)	Delivery (a little bit fast, sometimes um's, little projecting voice, little enthusiasm)	Delivery (good pace, usually projects voice, some enthusiasm)	Delivery (excellent pace, projects voice, great enthusiasm)		

Questions	Novice (1)	Apprentice (2)	Proficient (3)	Exemplary (4)	Score	Comments
•**Asks audience for questions**	Does not ask for questions	rarely ask for questions	Asks for questions	Effectively opens ("I'd be happy to answer questions")		
•**Answers questions effectively and smoothly**	Does not answer questions adequately	rarely answer questions adequately	Answers questions adequately	Answers questions effectively and smoothly		

Data Collection and Evaluation: Sample Rubrics Data

Course	Students Sample Count	Outcome Rubrics													
		a	*b*	*c*	*d-I*	*d-II*	*e*	*f*	*g-O*	*g-W*	*h*	*i*	*j*	*k*	*n*
COE 305	3		3.17												
COE 344	6		3.29												
COE 351	18 (g-O) 3 (a,c) 0 (d-I) 4 (others)	2.11		2.60		3.13	2.38		2.81	2.53	2.75	2.66	2.75	2.75	2.50
COE 390	24							2.58							
COE 400	1 (g-O) 2 (b,k,n) 3 (others)	2.33	3.21	2.25	3.24	3.33	2.83		3.80	1.92	1.56	2.50	1.33	3.25	2.50
COE 485	4 (g-O) 0 (d-I) 1 (others)	4.00		3.60	0.00	3.00	4.00		2.75	3.67	3.33	3.83	3.00	4.00	4.00
Average	*2.73*	*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*

Missing

d-I : outcome (d) - Part I (peer evaluation)
d-II : outcome (d) - Part II (instructor evaluation)
g-O : outcome (g) - Oral Presentation
g-W : outcome (g) - Writing Skills

Data Collection and Evaluation: Sample Rubrics Data

Course	Students Sample Count	Outcome Rubrics													
		a	*b*	*c*	*d-I*	*d-II*	*e*	*f*	*g-O*	*g-W*	*h*	*i*	*j*	*k*	*n*
COE 305	5		3.60												
COE 344	3		3.08												
COE 351	10 (g-O) 6 (g-W) 3 (others)	1.82		2.13		0.00	2.38		2.81	2.77	2.30	2.90	2.50	2.40	2.32
COE 390	6							3.50							
COE 399	24 (g-O) 16 (g-W)								2.72	2.45					
COE 400	4 (a,e,d-I) 1 (g-O) 5 (others)	1.75	2.80	2.36	2.39	2.80	3.00		3.80	2.64	1.80	3.00	1.20	2.60	2.70
COE 485	1 (a,d-I) 2 (d-II,j) 5 (g-O) 3 (others)	3.00		2.57	3.00	3.50	3.50		2.90	2.27	2.11	3.28	2.00	2.83	3.00
Average	*2.64*	*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*

Missing

d-I : outcome (d) - Part I (peer evaluation)
d-II : outcome (d) - Part II (instructor evaluation)
g-O : outcome (g) - Oral Presentation
g-W : outcome (g) - Writing Skills

Data Collection and Evaluation: COE Industrial Advisory Committee

- Since 2006, the COE IAC has eight members:
  - Six from the local Industry
  - Two from the COE department
- IAC Goal: Provide feedback to assist the COE Department in achieving its mission and objectives
- First meeting on April 25, 2007
  - Attended by all COE faculty and by students representatives
  - CCSE Dean and chairmen of SE and ICS departments were invited
  - The main issue discussed is how to improve the "Relationship between COE-KFUPM and Industry"

Data Collection and Evaluation: Exit Survey

- The COE graduating students gave high rating (> 80%) to:
  - Ability to apply general principles of mathematics, science, and engineering to analyze and solve computer engineering problems
  - Quality and variety of COE design projects helpful in developing engineering design skills
  - Oral and written communication skills
  - Understanding of the impact of computer engineering solutions in my society and in the world
  - Understanding the contemporary social, political, and technical issues that surround our society
  - Ability to integrate different hardware and software components of a system to come up with a solution to a practical problem or need

- The COE graduating students gave relatively moderate rating (68.8% - 79%) to:
  - Teamwork experience
  - The training and practice in the areas of software design and development
  - Engage in a lifelong learning process
  - Use software and hardware tools needed to solve computer engineering problems

Data Collection and Evaluation: COE Alumni Survey

- The COE Program Educational Objectives Assessment Summary is based on 50 Alumni who were surveyed
- All COE Program education objectives rated with a good rating with the least rating being 66.4% (3.32/5):
  - Practice the profession as a computer engineer with confidence
  - Make intellectual contribution to my profession
  - Technical breadth
  - Technical depth
  - Importance of superior work ethics in the practice of the profession
  - Importance of good character in the practice of the profession
  - Ability and motivation to continuously improve the technical skills
  - Background that can be built on to continue higher studies for the MS and PhD degrees.
- The ones that achieved the lowest rating and need improvement are:
  - Training for professionally adapting to changes in the field
  - Background to be globally (worldwide) competitive in the profession
  - Background to improve the personal skills (e.g., teamwork, leadership, oral and written communication skills, etc.) in the work place

Assessment Plan

Planning of the PEOs and POs Review Process and Frequency	2006-2007	2007-2008	2008-2009	2009-2010
Review of the Program Educational Objectives PEOs (every 3 years)	X			X
Review of the Program Outcomes (every 3 years)	X			X

Planning the review process of the PEOs and POs

Planning the POs Indirect Assessment	T081	T082	T091	T092	T001	T002
Survey of Alumni and Employers (every 3 years)					X	X
Survey of COE Graduates and Coop Supervisors (every semester)	X	X	X	X	X	X
Meeting and consulting the Industry Advisory Board (every year)		X		X		X

Planning the Indirect Assessment and Consulting the Industry Advisory Board.

Closing the Loop

The COE Direct Assessment cycle is 3 years:

1. First year: a sub-set of program outcomes is examined for possible improvement. If needed some action is taken to improve needing POs. The committee documents its analysis and the improvement actions.

2. Second year: the remaining sub-set of program outcomes is examined for possible improvement. If needed some action is taken to improve needing POs. The committee documents its analysis and the improvement actions.

3. Third year: Data collection is done for all outcomes. The results of continuous improvement are analyzed. The committee documents its assessment data analysis and conclusions.

Closing the Loop

Planning Continuous Improvement and Program Assessment	T081	T082	T091	T092	T001	T002
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 Assessment Data. A(math/science), B(experiments), F(ethics), H(eng. sol.), I(learning), K(tools), and M(dis. math).		X		X		
Program Assessment (Direct Assessment: Rubrics and Exit Exam)					X	X

Planning the Continuous Improvement and Program Assessment process.

Closing the Loop

The COE ABET committee analyzed the assessment data out for T062, T071, and T072 using the Direct and Indirect assessment tools. Committee observation:

- Data fluctuation which can be improved through
  1. Improve awareness of the faculty of Assessment and Accreditation by enforcing attendance of appropriate Workshop to be offered by the University (rec. made to Assessment Center)
  2. Request that assessment be done as soon as possible without delay which requires automated assessment tool and new regulation. In the COE we already re-organized Course File so that to include Rubrics Assessment Sheets for each course. The department will follow-up at CF submission.
  3. Improve statistics due to few rubric sample in some cases.
  4. Provide incentives to faculty to automate assessment process and offer grant to faculty which are more involved in Rubric Assessment (rec. made to Assessment Center).
  5. Provide grant to faculty to develop an outcome-based student evaluation for 400-level courses involved in Rubrics Assessment to avoid two parallel evaluation systems.
  6. Decided to improve Outcome C (design) and assigned one faculty to coordinate the continuous improvement process.

Closing the Loop

To improve Outcome C (design), one COE faculty coordinated the continuous improvement process. The actions taken were the following:

1. Meeting with the instructor of Major 400-level courses involved in the Engineering Design and together decided:
    - Offering of two lectures on Engineering Design in each course (Capstone, Senior Project, and Coop)
    - Provided lectures and Guidelines for the instructor and students on Eng. Des.
    - Communicated with Coop students and provided some detailed and summarized guidelines
2. Recommended to curriculum committee to improve the Engineering Design practices in 200, 300 and 400 levels. The approach must be systematic and progressive.
    - 200-level Labs: only definition and analysis of alternate solutions
    - 300-level Labs: definition, specifications, analysis of alternate solutions, and meeting criteria.
    - 400-level: integration of Engineering design, economical, and ethical apsects

Summary

- The COE department is seeking accreditation from ABET EC 08-09 as a strategy to provide quality assurance for its BSc program
- The COE department is determined to improve its program both the technical and behavioral components to meet EC 2K 08-09
- New instruction techniques for outcome-based education will be gradually attempted at some levels to improve the quality of the Computer Engineer compared to some international standard.
- The Industrial Advisory Board is one important channel to provide the department with feedback on the achievement of long term educational objectives as experienced by our graduate.

Thank you

Feedback from the audience:

- Assessment of your Program Educational Objectives is better be done only using the Alumni and the Employer surveys. It not proper to involve the Industry Advisory Board in this issue.
- In a given semester, it is suggested to carry out rubrics assessment for sub-set of program outcomes not all.