# Oregon Institute of Technology
# Computer Systems Engineering Technology Department
# Embedded Systems Engineering Technology Program Assessment
# 2013-14

## I. Introduction

The Embedded Systems Engineering Technology (ESET) program was proposed to OUS in spring of 2006 and approved in August, 2006. The curriculum for the ESET program is common with the hardware and software programs for the freshman year. The sophomore year of the ESET program has been constructed to mirror the track through both the Computer Engineering Technology (CET) and Software Engineering Technology (CET) programs, called the Dual Degree program. The ESET program junior year is when ESET students get instruction specific to topics of embedded systems engineering. These courses were taught for the first time in fall, 2008.

## II. Mission, Objectives and Program Student Learning Outcomes

The mission of the Embedded Systems Engineering Technology (ESET) Degree program within the Computer Systems Engineering Technology (CSET) Department at Oregon Institute of Technology is to prepare our students for productive careers in industry and government by providing an excellent education incorporating industry-relevant, applied laboratory based instruction in both the theory and application of embedded systems engineering. Our focus is educating students to meet the growing workforce demand in Oregon and elsewhere for graduates prepared in both hardware and software aspects of embedded systems. Major components of the ESET program's mission in the CSET Department are:

I. To educate a new generation of Embedded Systems Engineering Technology students to meet current and future industrial challenges and emerging embedded systems engineering trends.

II. To promote a sense of scholarship, leadership, and professional service among our graduates.

III. To enable our students to create, develop, apply, and disseminate knowledge within the embedded systems development environment.

IV. To expose our students to cross-disciplinary educational programs.

V. To provide government and high tech industry employers with graduates in embedded systems engineering and related professions.

### Program Educational Objectives

The Program Educational Objectives reflect those attributes a student of the ESET program will practice in professional endeavors.

A. Graduates of the embedded program are expected to understand societal impact of embedded systems and technological solutions.

B. Graduates of embedded degree program are expected to do hardware/software co-design for embedded systems. Graduates will continue to develop skills in analysis, approach, optimization, and implementation of embedded systems.

C. Graduates of the embedded program are expected to obtain the knowledge, skills and capabilities necessary for immediate employment in embedded systems. Embedded Systems is a profession increasingly driven by advances in technology, therefore graduates are expected to obtain the necessary life-long learning skills to enable them to be able to adapt to a changing environment.

D. Graduates of the embedded program are expected to develop a broad base of skills. These skills will prepare them for professional practice: 1) as embedded engineers, 2) participants in embedded development teams, and 3) effective communicators within a multidisciplinary team.

E. Graduates of the embedded program are expected to acquire knowledge of management and marketing of embedded projects and products and to prepare for series production.

## Program Student Learning Outcomes

Embedded Systems Engineering Technology baccalaureate graduates will be engaged in:

1. Application of mathematics including differential and integral calculus, probability, and discrete mathematics to hardware and software problems (Objectives C, D, E).

2. Application of project management techniques to embedded systems projects (Objectives C and D).

3. Application of knowledge of embedded systems engineering technology, along with some specialization in at least one area of computer systems engineering technology. (Objective D)

4. A broad education and knowledge of contemporary issues necessary to reason about the impact of embedded system based solutions to situations arising in society. (Objective A)

5. Identification and synthesis of solutions for embedded systems problems. (Objective B, C)

6. Design, execution and evaluation of experiments on embedded platforms. (Objective C, D)

7. Analysis, design and testing of systems that include both hardware and software. (Objective B, D)

8. Documenting the experimental processes and to writing of satisfactory technical reports/papers. (Objective D, E)

9. Delivery of technical oral presentations and interacting with a presentation audience. (Objective D, E)

10. Recognition for and the motivation to further develop their knowledge and skills as embedded engineering advances occur in industry. (Objective C)

11. Working effectively, independently, and in multi-person teams. (Objective D)

12. Professional and ethical execution of responsibilities. (Objective A, D)

## III. Three-Year Cycle for Assessment of Student Learning Outcomes

Assessment activities for the ESET program began Fall, 2008. Table 1 presents planned learning outcome assessment on a three year cycle. The rows of this table correspond to the PSLO. The entries in the cells corresponding to the year represent mapping from the row (PSLO) to the ISLO. The number in the cells of the table corresponds to the ISLO defined for the OIT assessment cycle:

- ISLO 1: OIT students will demonstrate effective oral, written and visual communication.
- ISLO 2: OIT students will demonstrate the ability to work effectively in teams and/or groups.
- ISLO 3: OIT students will demonstrate an understanding of professionalism and ethical practice.
- ISLO 4: OIT students will demonstrate critical thinking and problem solving.
- ISLO 5: OIT students will demonstrate knowledge and understanding of career development and lifelong learning.
- ISLO 6: OIT students will demonstrate mathematical knowledge and skills.
- ISLO 7: OIT students will demonstrate scientific knowledge and skills in scientific reasoning.
- ISLO 8: OIT students will demonstrate cultural awareness.

**Table 1: Baccalaureate Outcome Assessment Timeline**

| # | Learning Outcomes | 08-09 | 09-10 | 10-11 | 11-12 | 12-13 | 13-14 |
|---|---|---|---|---|---|---|---|
| 1 | The ability to apply mathematics including differential and integral calculus, probability, and discrete mathematics to hardware and software problems. | **6** | | | **6** | | |
| 2 | An ability to apply project management techniques to embedded systems projects. | | **2, 3** | | | **2, 3** | |
| 3 | Knowledge of embedded systems engineering technology, along with some specialization in at least one area of computer systems engineering technology. | | | **4** | | | **4** |
| 4 | A broad education and knowledge of contemporary issues necessary to reason about the impact of embedded system based solutions to situations arising in society. | | **3, 8** | | | **3, 8** | |
| 5 | The ability to identify and synthesize solutions for embedded system problems. | | | **4** | | | **4** |
| 6 | The ability to design, conduct and evaluate the results of experiments on embedded platforms. | **7** | | | **7** | | |
| 7 | The ability to analyze, design and test systems that include both hardware and software. | **7** | | | **7** | | |
| 8 | The ability to document experimental processes and to write satisfactory technical reports/papers. | | | **1** | | | **1** |
| 9 | The ability to make technical oral presentations and interact with an audience. | | | **1** | | | **1** |
| 10 | The recognition for and the motivation to further develop their knowledge and skills as embedded engineering advances occur in industry. | | | **5** | | | **5** |
| 11 | The ability to work effectively independently and in multi-person teams. | | **2** | | | **2** | |
| 12 | An understanding of professional and ethical responsibility. | | **3, 8** | | | **3, 8** | |

To summarize, Table 2 shows the program learning outcomes (identified by number only) that will be assessed for each of the next three years.

**Table 2: Summary of Assessment Timeline**

| Academic Year | Outcomes |
|---|---|
| 2011-12 | 1, 6, 7 |
| 2012-13 | 2, 4, 11, 12 |
| 2013-14 | 3, 5, 8, 9, 10 |

Outcomes to be assessed are listed below:

3. Application of knowledge of embedded systems engineering technology, along with some specialization in at least one area of computer systems engineering technology.
5. Identification and synthesis of solutions for embedded systems problems.
8. Documenting the experimental processes and writing of satisfactory technical reports/papers.
9. Delivery of technical oral presentations and interacting with a presentation audience.
10. Recognition for and the motivation to further develop their knowledge and skills as embedded engineering advances occur in industry.

Target courses where the assessment tools were to be applied for the 2013-14 academic year are summarized in Table 3.

**Table 3: 2013 – 2014 Summary Courses of Assessment Application**

| Outcome | Courses | Term |
|---|---|---|
| 3 | CST 417 – Embedded Networks<br>CST 204 – Microprocessors | Fall<br>Winter |
| 5 | CST 162 – Digital Logic<br>CST 466 - Cryptography | Fall<br>Spring |
| 8 | CST 345 – HW/SW Co-Design<br>CST 105 – Intro to Computer Systems III | Winter<br>Spring |
| 9 | CST 412 – Senior Development Project I<br>CST 371 – Embedded Systems Development I | Fall<br>Fall |
| 10 | CST 417 – Embedded Networks<br>CST 204 – Microprocessors | Fall<br>Winter |

## IV. Summary of 2013-14 Assessment Activities

The following are the direct assessment activities that were accomplished during 2013 - 2014 academic year. Each activity is introduced with a description of the activity followed by a table

that summarized the rubric criteria along with the rubric application results. Where available, the rubric used for assessment is shown in Appendix A.

## PSLO #3

Application of knowledge of embedded systems engineering technology, along with some specialization in at least one area of computer systems engineering technology.

### CST 417– Embedded Networks: Fall 2013

Computer networks is a course on network theory and implementation through the TCP/IP protocol suite.

Data Collection Date: Fall 2013 Coordinator: Troy Scevers

*Assessment Method:* Students were given a standard assignment for writing an essay on the field of embedded systems engineering and expectations related to the professional field. The Embedded Systems Engineering Technology Embedded Systems Knowledge Rubric was used to evaluate the essays (see Appendix). Results are shown in Table A.1.

| Performance Criteria | Assessment Method | Measurement Scale | Minimum Acceptable Performance | Results |
|---|---|---|---|---|
| Field Description | Written Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 1 of 4<br>25% |
| Expectations | Written Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 2 of 4<br>50% |
| Target Products | Written Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 2 of 4<br>50% |
| Skill Definition | Written Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 1 of 4<br>25% |
| Target Companies | Written Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 1 of 4<br>25% |

Table A.1 – Assessment outcome results for CST 417 – *Embedded Networks*

*Evaluation of results:* Students gave only the vaguest of answers for embedded systems knowledge. I believe part of the reason for this is the primary purpose of the assignment was for lifelong learning. Students concentrated more on that aspect than the embedded systems knowledge aspect.

*Actions:* This assessment should be a different assignment than the essay used for lifelong learning. Almost all responses on the survey were dealing directly with lifelong learning. Need to make a separate assignment for Embedded systems knowledge. Also, Embedded networking is taken by Dual students as well as embedded student so might need to find a different class to evaluate this piece.

*Closing the Loop:* The last time this outcome was assessed, assessment was done on two students. The results of the previous results were:

> *Evaluation of results:* The number of students in this assessment makes the results of no statistical relevance. Given the sample size of two, we cannot draw any conclusions related to the effectiveness of the program for this PSLO.
>
> *Actions:* This will be re-assessed in the next assessment cycle involving this PSLO. The program is growing so we will have more involved students at that time.

This time around there were 4 students involved in the assessment, not yet a sample of statistical significance.

**CST 204 – Microprocessors: Winter 2014**

Microprocessors focuses on details of microprocessor based digital systems. Students in this course are sophomore level and have just chosen the ESET program and their major program of study.

Data Collection Date: 3/5/2014 Coordinator: Claude Kansaku

*Assessment Method:* On Exam 2, students were asked to identify design aspects of an embedded systems application. The application was from a lab that required turning a stepper motor in a combinations of directions and speeds. The students were asked to identify whether the parameter was best controlled by hardware or software or either or neither. At the sophomore level, design is not an emphasis, yet. However, students begin to recognize design parameters and how they affect the system function. Furthermore, even if a student has not designed a system function, they will begin to gain awareness on how the parameter affects the system operation.

The questions were as follows:

1. 1 - 5 (Number of appropriate responses): State five design parameters that go into the design of a stepper motor application. (These may or may not be microcontroller related.)
2. 0 - 5 (Number of appropriate responses): For the parameters listed in the previous question (Q1), indicate if it is best controlled by embedded HW, SW, either, or neither.

The minimum level of achievement set by the faculty was a response of 3 or more for each question. The results from the exams are shown in table A.2:

| Sample | Q1 | Q2 |
|---|---|---|
| 1 | 5 | 5 |
| 2 | 5 | 5 |
| 3 | 5 | 5 |
| 4 | 3 | 5 |
| 5 | 4 | 5 |
| 6 | 2 | 2 |
| 7 | 1 | 1 |
| 8 | 5 | 5 |
| 9 | 5 | 5 |
| 10 | 5 | 5 |
| 11 | 4 | 4 |
| 12 | 5 | 5 |
| % of students met criteria | 83% | 83% |

Table A.2 – Assessment outcome results for CST 204 – *Microprocessors*

*Evaluation of results:* This assessment, along with the Application and Test Assessment, were based on a lab project that required students to use a microcontroller/programming to turn a unipolar stepper motor in various configurations of direction and speed. All students were successful in demonstrating the lab requirements. In addition, students were able to appropriately identify the various design considerations affecting the system operation. Although design is not focused on at this level, students are appropriately beginning to understand the choices they make and the impacts of those choices.

*Actions:* Students performed well on this assessment. No action is required.

*Closing the Loop:* The results of the last assessment cycle in the 2010-2011 academic year was:

> *Evaluation of results*: There were several problems with this assessment. The assignment, as defined for the lifelong learning and writing, was not specific enough to bring about the results described in the Embedded Systems Engineering Technology Embedded Systems Knowledge Rubric. This was suspected going into the assessment cycle, but given time limitations, the assessment was performed to gauge how the assignment could be modified to better fill the institutional and program goals in a single assignment. The level of students at the time of assessment administration is also such that there have been no courses taken specific to embedded systems subjects, so it is difficult for students to differentiate between software engineering, hardware engineering, and embedded systems engineering. The number of students assessed also has problems related to statistical significance.
>
> *Actions*: The assessment method and placement will be reviewed and run in the next assessment cycle for this PSLO.

In this assessment cycle, the method has been modified and adapted utilizing an exam rather than a written assignment. This made the assessment exercise a more natural fit into the course.

## PSLO #5

Identification and synthesis of solutions for embedded systems problems.

### CST 162 – Digital Logic: Fall 2013

Digital Logic is a first course introduction to digital logic and related computer components. This assessment focuses on the design of a solution to a problem.

Data Collection Date: 11/14/2013 Coordinator: Phong Nguyen

*Assessment Method:* Students (48 total) in CST 162 were given a set of specifications to a digital logic design problem. They are next required to follow a specific method to come up with a design which they are to implement using gates. At the end, the students are asked to check a truth table to partially check functionality of the design. Student work was assessed in each of the following performance criteria as defined in the attached rubric. The results are summarized in table A.3.

| Performance Criteria | Assessment Method | Measurement Scale | Minimum Acceptable Performance | Results |
|---|---|---|---|---|
| Understanding | Problem Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 45 of 48<br>94% |
| Plan to Solve | Problem Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 44 of 48<br>92% |
| Carrying out the Plan | Problem Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 35 of 48<br>73% |
| Evaluating | Problem Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 37 of 48<br>77% |
| Solution | Problem Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 34 of 48<br>70% |

Table A.3 – Assessment outcome results for CST 162 – Digital Logic

*Evaluation of results:* The performance passed standard that we would expect at this level.

*Actions:* No formal action is required.

*Closing the Loop:* The result of the previous assessment cycle 2010-2011 was:

*Evaluation of results*: The performance passed standard.

*Actions*: No Action Required

Given these results, students are performing at acceptable levels.

**CST 466 – Cryptography: Spring 2014**

Cryptography focuses on topics related to security in embedded systems.

This assessment focuses on the design of a solution to a problem.

Data Collection Date: 4/4/2014 Coordinator: Phong Nguyen

*Assessment Method:* Assessment Method: Cryptography is a course which familiarizes the students with private and public key cryptographic systems. In this quiz, the students are required to recognize and apply methods of encryption/decryption to provide a digital signature in order to prevent a "man in the middle" attack using the RSA system. Student work was assessed in each of the following performance criteria, shown in Table A.4, as defined in the rubric as shown in Appendix A.

| Performance Criteria | Assessment Method | Measurement Scale | Minimum Acceptable Performance | Results |
|---|---|---|---|---|
| Problem Identification | Problem Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 4 of 5<br>80% |
| Solution Clarification | Problem Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 5 of 5<br>100% |
| Evaluation | Problem Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 4 of 5<br>80% |

Table A.4 – Assessment outcome results for CST 466 – Embedded Systems Security

Evaluation of results: The concept of a digital signature using RSA is complicated. For all three criteria (Identification, Clarification and Evaluation), if the students achieve an average of 3.1 out of 4 possible, then the students are assessed as successful. All average scores were above 3.1

Actions: None at this time.

*Closing the Loop:* The result of the previous assessment cycle 2010-2011 was:

*Evaluation of results*: The performance passed standard.

*Actions*: No Action Required

Given these results, students are performing at acceptable levels.

## PSLO #8

Documenting the experimental processes and to writing of satisfactory technical reports/papers.

### CST 105 – Intro to Computer Systems III: Spring 2014

Intro to Computer Systems III focuses on details of computer development and different levels of computer based development activity. Students in this course are freshman level and have not yet chosen the ESET program and their major program of study.

Data Collection Date: 4/1/14 Coordinator: Phong Nguyen

Assessment Method: A paper on lifelong was assigned. Each individual was required to fulfill the specifications of technical writing from a rubric when writing this paper. Results are summarized in table A.5.

| Performance Criteria | Assessment Method | Measurement Scale | Minimum Acceptable Performance | Results |
|---|---|---|---|---|
| Development | Writing Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 9 of 9<br>100% |
| Organization | Writing Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 8 of 9<br>89% |
| Writing Style | Writing Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 9 of 9<br>100% |
| Research | Writing Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 4 of 9<br>44% |
| Format | Writing Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 7 of 9<br>78% |
| Convention | Writing Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 5 of 9<br>56% |

Table A.5 – Assessment outcome results for CST 105 – *Intro to Computer Systems III*

Evaluation 4/18/14 As expected, the technical writing skills at the freshman leave much to be desired. There exists the rare one or two who possess the knowledge required to be a proficient technical writer. These students will have many chances to write technical reports as well as take a class in technical writing

Actions 4/18/14 In 3 years when some of these students become seniors in the major, they will be given the same paper to assess their maturity and the classes that assisted them in learning the skills of technical writing.

*Closing the Loop:* This PSLO was not done in CST 105 for the previous assessment cycle 2010-2011.

### CST 345 – HW/SW Co-Design: Winter 2014

HW/SW Co-Design is a course on embedded system design taking hardware and software requirements into account when producing a system on a chip platform.

Data Collection Date: Winter 2014 Coordinator: Troy Scevers

*Assessment Method:* Report for take-home final project.

| | | | Minimum | |
|---|---|---|---|---|

| Performance Criteria | Assessment Method | Measurement Scale | Acceptable Performance | Results |
|---|---|---|---|---|
| Purpose and Ideas | Final Project Report | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 5 of 6 83% |
| Organization | Final Project Report | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 5 of 6 83% |
| Support | Final Project Report | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 5 of 6 83% |
| Style | Final Project Report | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 5 of 6 83% |
| Conventions | Final Project Report | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 5 of 6 83% |
| Documentation | Final Project Report | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 5 of 6 83% |

Table A.6 – Assessment outcome results for CST 345 – *HW/SW Co-Design*

*Evaluation of results:* The final reports were well organized with students scoring at least a three in each category. Students have a very good grasp on how to write a technical report for a given problem.

*Actions:* none

*Closing the Loop:* This PSLO was not done in CST 345 for the previous assessment cycle 2010-2011.

**PSLO #9**

Delivery of technical oral presentations and interacting with a presentation audience.

### CST 105 – Intro to Computer Systems III: Spring 2014

Intro to Computer Systems III focuses on details of computer development and different levels of computer based development activity. Students in this course are freshman level and have not yet chosen the ESET program and their major program of study.

Data Collection Date: 4/28/2014 Coordinator: Phong Nguyen

Assessment Method: One Junior Project group presented its Design Review to a class of freshman in CST 105. The freshmen were formed into groups of 4, asked to propose a make-believe project when they become juniors. The groups are asked to complete a

PowerPoint presentation and do a mock presentation of their proposals. Assessment was done during the course of the speech based on the OIT public speaking rubric. Results are shown in Table A.7.

| Performance Criteria | Assessment Method | Measurement Scale | Minimum Acceptable Performance | Results |
|---|---|---|---|---|
| Content | Speech Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 22 of 30<br>73% |
| Organization | Speech Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 21 of 30<br>70% |
| Style | Speech Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 17 of 30<br>57% |
| Delivery | Speech Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 12 of 30<br>40% |
| Visuals | Speech Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 24 of 30<br>83% |

Table A.7 – Assessment outcome results for CST 105 – Intro to Computer Systems III

*Evaluation of results:* Students were asked to watch a genuine JP presentation before preparing and presented themselves. In the end, they did not do as well as the juniors they watched. This is to be expected since they have not been taught oral presentation skills.

*Actions:* The same freshman will be assessed in 2-3 years to see the improvements.

*Closing the Loop:* This PSLO was not done in CST 105 for the previous assessment cycle 2010-2011.

### CST 412 – Sr. Project Development I: Fall 2013

Students in CST 412 are in the first term of their Sr. year. Students are expected to have a good level of proficiency in technical public speaking. Each student in the course is required to give at least a five minute speech explaining some technical aspect of their project. These speeches must be supported with professional facts and visuals.

Data Collection Date: 12/05/2013 Coordinator: Calvin Caldwell

Assessment Method: 21 students presented their Senior Projects to their classmates. These presentations were the assessed using a predefined institutional rubric. The results of the assessment are shown in Table A.8.

| Performance Criteria | Assessment Method | Measurement Scale | Minimum Acceptable Performance | Results |
|---|---|---|---|---|
| Content | Speech Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 19 of 21<br>90% |
| Organization | Speech Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 19 of 21<br>90% |
| Style | Speech Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 20 of 21<br>95% |
| Delivery | Speech Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 20 of 21<br>95% |
| Visuals | Speech Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 19 of 21<br>90% |

Table A.8 – Assessment outcome results for CST 412– Sr. Project Development I

Evaluation of Results:

Evaluation 12/5/13

2 students were basically unprepared. Overall, the presentations went well. If there was one common negative, it was that several presentations were a bit on the short side.

Actions 12/5/13

Next time, emphasis will be placed on presenting throughout the fully allotted time.

*Closing the Loop:* The result of the previous assessment cycle 2010-2011 was:

> *Evaluation of results:* The number of students involved in this assessment makes the results of no statistical relevance; however, the students passed the assessment benchmark.
>
> *Actions:* No action is required.

In this round of assessment, the student population consisted of all Sr. Project students rather than specifically the ESET students. This gives a better result from a statistical perspective.

## PSLO #10

Recognition for and the motivation to further develop their knowledge and skills as embedded engineering advances occur in industry.

### CST 417 – Embedded Networks: Fall 2013

Embedded networks is a course on network theory and implementation in embedded platforms through the TCP/IP protocol suite.

Data Collection Date: Fall 2013 Coordinator: Troy Scevers

*Assessment Method:* Students were given a standard assignment for writing an essay on the importance of lifelong learning in the field of embedded systems. The OIT Lifelong Learning rubric was used to assess these essays. TableA.9 shows the results of this assessment.

| Performance Criteria | Assessment Method | Measurement Scale | Minimum Acceptable Performance | Results |
|---|---|---|---|---|
| Lifelong learning | Writing Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 4 of 4<br>100% |
| Professional societies and organizations | Writing Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 1 of 4<br>25% |
| Credentials | Writing Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 0 of 4<br>0% |
| Continuing education | Writing Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 3 of 4<br>75% |
| Short- and long-term career plans | Writing Assignment | No Proficiency (1)/ Some Proficiency (2)/ Proficiency (3)/ High Proficiency (4) | Proficiency (3) | 4 of 4<br>100% |

Table A.9 – Assessment outcome results for CST 417 – *Embedded Networks*

*Evaluation of results:* Students did well in defining lifelong learning and their understanding of it. There was good examples of all students analysis of themselves with both strengths and weaknesses. Only one student mentioned a professional society and no one mentioned credentials at all. These aspects were not covered in the assignment well and had low visibility to the students. Continuing education was on the thoughts of most of the students in the form of either classes or seminars that they would be able to attend once out of school. All students had a good grasp of their career plans and a path to get them there. They had very realistic expectations for their careers and goals.

*Actions:* Need to discuss credentials and professional societies more with the students. They need to be aware of the benefits that a professional society can bring them with continuing education and lifelong learning.

*Closing the Loop:* The result of the previous assessment cycle 2010-2011 was:

> *Evaluation of results:* The sample size for this assessment was small enough such that the results have no real statistical significance. Results of the assignment are poor; however, after the assignment was collected, both students were interviewed about industry developments and their plans for staying current in a technically volatile field. Both students were well informed and had plans to continue learning about embedded systems after graduation.
>
> *Actions:* This will be re-assessed in the next assessment cycle involving this PSLO. The program is growing so we will have more involved students at that time.

This time around, assessment was done with a class of size 4. This remains of little statistical significance. Recruiting efforts for the ESET program are being re-evaluated.

**CST 204 – Microprocessors: Winter 2014**

Microprocessors focuses on details of microprocessor based digital systems. Students in this course are sophomore level and have just chosen the ESET program and their major program of study.

Data Collection Date: 3/18/2014 Coordinator: Claude Kansaku

*Assessment Method:* At the end of the term, students were randomly put in three or two person teams to investigate and present an embedded microcontroller device not covered in the class. Each of the four teams were required to do a PPT presentation that addressed the following:

20 min presentation using original PPTs:

- Processor-related
  - o Describe fundamental architectural characteristics, comparing and contrasting with MIPS32
  - o Briefly look at several instructions and how they compare and contrast with MIPS32
- Peripherals-related
  - o Describe peripheral set highlighting one or two “cool” functions or implementations
  - o Highlight any limitations in your opinion

Although investigation could be distributed, all team members were expected to be knowledgeable of the entire presentation's content. That is, each team member should have been able to answer questions on behalf of the entire team.

Reflecting on their previous and newly acquired knowledge, students were directed to assess their need for future learning and its importance in their careers. Students were asked to answer the following questions:

1. T or F: I had heard of my team's microcontroller before this assignment.
2. 1 - 4: I had heard of _____ of the four specific microcontroller devices before this assignment.
3. 5-1 (Helped a lot - Did not help at all): My current skills and knowledge of embedded microcontrollers helped me prepare and contribute towards my team's presentation.
4. 5-1 (Will definitely happen - Will never happen): In my career, I believe the likelihood that I will have to independently learn a new embedded technology (HW or SW) is:
5. 5-1 (Very significant - Very insignificant): In my career, I foresee learning on my own to be a significant contribution to any team's success.
6. 0 - 2 (Number of reasonable responses): Based on your response to the previous question (Q5), give two reasons why independent learning will be significant or not.

Results are shown in Table A.10.

| Samp | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 |
|---|---|---|---|---|---|---|
| 1 | F | 1 | 5 | 4 | 5 | 2 |
| 2 | T | 2 | 3 | 3 | 4 | 2 |
| 3 | F | 1 | 3 | 5 | 5 | 2 |
| 4 | F | 1 | 4 | 5 | 4 | 2 |
| 5 | F | 0 | 2 | 5 | 5 | 2 |
| 6 | T | 1 | 4 | 4 | 5 | 2 |
| 7 | F | 1 | 1 | 5 | 5 | 2 |
| 8 | F | 1 | 5 | 4 | 4 | 2 |
| 9 | T | 2 | 4 | 5 | 5 | 2 |
| 10 | F | 1 | 3 | 5 | 5 | 2 |
| 11 | F | 1 | 2 | 4 | 4 | 2 |
| 12 | F | 1 | 4 | 5 | 5 | 2 |
| Average | 9 x F | 1.08 | 3.33 | 4.50 | 4.67 | 2.00 |
| | 3 x T | | | | | |

Table A.10 – Assessment outcome results for CST 204 – *Microprocessors*

*Evaluation of results:* Most students had not heard about the embedded device they were asked to investigate and present. However, they were all able to process the information to the level they had learned in the class. Though students were varied on whether or not their current knowledge was able to get them through the investigation, the presentations demonstrated through comparison and contrasts that they had indeed done so. As a group, every student believed learning new embedded technologies will be significant in their future careers. All students were able to provide appropriate reasons why this is so.

*Actions:* Students performed well on this assessment. No action is required.

*Closing the Loop:* The result of the previous assessment cycle 2010-2011 was:

*Evaluation of results:* The outcome of this assessment showed substandard results. At this point in the students career, they have not yet fully committed to the embedded systems program and have had no instruction specific to the field of embedded system engineering. It is no surprise that they do not have a good grasp on knowledge and skills required of an embedded systems engineer.

*Actions:* The assessment method and placement will be reviewed and run in the next assessment cycle for this PSLO.

After review of the assessment placement, it was determined that an early data point is beneficial in understanding a baseline for PSLO #10. The assessment method was modified to make it fit more seamlessly into the course content.

**Indirect Assessment**

At the end of each academic year, graduating senior are given an exit survey to determine where the students feel they are with respect to the PSLOs. For the 2013-2014 school year, out of three ESET graduate, one completed the survey. Students were asked to rank their abilities in:

1. Oral Communication
2. Written Communication
3. Mathematical Knowledge
4. Scientific Reasoning
5. Critical Thinking and Problem Solving
6. Lifelong Learning
7. Cultural Awareness
8. Professionalism
9. Ethical Practice
10. Team and Group Work

*Evaluation of results:* Although the results are statistically insignificant, in each of these areas, the student indicated felt either Proficient or Highly Proficient. The lower choices were Some Proficiency and No/Limited Proficiency.

*Actions:* Given the results, no action is required.

## V. Summary of Student Learning

## PSLO #3

Application of knowledge of embedded systems engineering technology, along with some specialization in at least one area of computer systems engineering technology.

*Evaluation of results:* The lab assignment was a good measure of student learning for this outcome. All students were successful in demonstrating the lab requirements. In addition, greater than 80% of the students were able to identify specific knowledge of embedded systems design associated with the lab. The written assignment was not very valuable in assessing student learning for this outcome. Another assignment will be developed for a second assessment measure next time this outcome is assessed in the cycle.

*Actions:* Though students have met faculty expectations for this outcome, a more appropriate assignment will be developed for a second assessment measure in 2016-17.

### PSLO #5

Identification and synthesis of solutions for embedded systems problems.

*Evaluation of results:* Student performance in the introduction course showed they were able to understand and plan to solve the embedded system problem and were developing the ability to implement that plan. Senior students in the embedded program met faculty expectations in identifying and synthesizing a result.

*Actions:* None needed at this time.

### PSLO #8

Documenting the experimental processes and writing of satisfactory technical reports/papers.

*Evaluation of results:* Students in the freshman level course were developing proficiency as technical writers. At the upper division level most students were able to meet faculty expectations in documentation and technical writing.

*Actions:* No actions necessary at this time.

### PSLO #9

Delivery of technical oral presentations and interacting with a presentation audience.

*Evaluation of results:* As with written communication, students showed good development of their oral communication skills over the course of their time in the program. Students in Senior Project met faculty expectations on delivery of technical presentations.

*Actions:* No actions needed.

## PSLO #10

Recognition for and the motivation to further develop their knowledge and skills as embedded engineering advances occur in industry.

*Evaluation of results:* Students at the senior level were proficient in identifying the need for continued professional development. Students were not able to identify specific credentials necessary for embedded systems engineers, this is expected since very few exist. Faculty agree that this criteria should be removed from the rubric. Most students did not reference professional organizations as a resource for lifelong learning. The assessment administered at the sophomore level was a good indication of student's ability to seek out knowledge on their own to solve complex issues, also a good predictor of their ability to be lifelong learners.

*Actions:* Faculty have identified CST 102 Intro to Computer Engineering as the best place in the curriculum to introduce students to professional organizations and their importance to their career. This outcome will be assessed again in 2016-17.