# AC 2008-1283: DEVELOPING A NEW COMPUTER ENGINEERING TECHNOLOGY FOCUS AREA IN ELECTRICAL ENGINEERING TECHNOLOGY PROGRAM: CURRICULUM ENHANCEMENT

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# Developing a new Computer Engineering Technology Focus area in Electrical Engineering Technology Program: Curriculum Enhancement


## Abstract

The School of Technology (SoT) plans to be nationally recognized for programs advancing technological education through excellence in learning, discovery, and engagement. To achieve this result, the electrical engineering program as part of SoT needs to continue improve and develop new majors that prepare graduates for careers in a wide scope industry and support a broad spectrum of technology. The Electrical Engineering Technology program needs to re-shape itself. The current focus of the program is Power and Industrial Control. Although this remains a key in the school of technology focus, the program needs to grow to serve a wide scope of industrial needs either local to state of Michigan or nationwide. This paper evaluates the current EET program, identifies a growth area of computer engineering technology and discusses the rationale for the addition of the Computer Engineering Technology focus area.


## 1 Introduction

In today's world of advanced computer technology, numerous applications are computer based. The need for highly qualified computer engineering technologists is increasing at a fast rate. Whether it is a PC or an Embedded Microprocessor, computers have changed the way we live our life. To respond to the industry needs of computer engineering technologists, the electrical engineering technology program is stepping up to this challenge by introducing a new computer engineering technology focus area.

The EET program has identified areas of specialization to enhance and strengthen the current EET curriculum and faculty body. The new EET program will attract more students by providing them with areas of specialization that prepare them for careers in a wide scope industry. The new specialization areas will represent and build a stronger EET program within the School of Technology.

Students of computer engineering technology will be given the opportunity to learn and experience the design and implementation of computer-based application. Graduates of the program represent a pool of informed computer engineering technologist from which industry can draw their potential staff.

The career opportunity awaiting the computer engineering technologists are excellent. According to the United States Department of Labor, the job outlook is on the rise and will be more favorable by employers. The experts in the US Bureau of Labor believe that a graduate with a bachelor's degree and relevant work experience will have higher chance in finding a job in this field. The graduate of the program will be able to work in hardware design, embedded system applications, FPGA design, computer systems analysis, and computer equipment maintenance/repair.

The Computer Engineering Technology program will be an addition to current Electrical Engineering Technology program, both program will represent the new Electrical and Computer Engineering Technology (ECET) Program. Initially Computer Engineering Technology (CpET) can be considered as a focus area within the EET program, students of EET program will have the option of a computer engineering technology focus area and still graduate from already accredited ABET program. Moving forward, the new computer engineering technology focus will be evolved into a program and then a proposal can be submitted for the stand alone Computer Engineering Technology Program.

## 2 Motivation

The main motivation for developing the new focus area in computer engineering technology was to respond to the market needs of skilled computer engineering technologist with skills in Embedded Systems and programmable logic (Field Programmable Gate Array: FGPA) Design. The addition of the new focus is a result of consultation with the program industry advisory board, where one of the members of the industry advisory board is a representative of Lattice Semiconductor, the third market leader of programmable logic. As a result, the School of Technology is stepping up to this challenge by introducing the new focus area to give the students of Electrical Engineering Technology program the opportunity to learn and experience the design and implementation of computer-based application. Industry's commonly used software development tools are used in several courses of the program. Through industry standard approaches, the students learn state-of-the art problem solving and development techniques.

Currently, the number of courses offered in Computer Engineering Technology represents a shortage of coverage. It is much less coverage than similar programs at peer institutes. To strengthen the area of Computer Engineering Technology, more courses need to be added to the current curriculum, the paper suggested a list of the courses that can be offered in Computer Engineering Technology area.

## 3 EET Program Outcomes

The EET Program Outcomes capture the desired attributes that the EET program at School of Technology (SoT) aspires to impart on its students through the curriculum and academic experience. The desired outcomes of the EET program were adopted from ABET's (a) through (k) outcomes[1] Shown in Table 1 as Outcome 1 through Outcome 11 as well as ABET's Electrical/Electronics Engineering Technology Program Criteria Outcomes[1] shown in Table 1 as Outcome 12 through Outcome 16.

**Table 1 Electrical Engineering Technology Program Outcomes [11]**

| | |
|---|---|
| Outcome 1 | An appropriate mastery of the knowledge, techniques, skills and modern tools of the discipline (ABET 2.a ) |
| Outcome 2 | An ability to apply current knowledge and adapt emerging applications of mathematics, science, engineering and technology (ABET 2.b ) |
| Outcome 3 | An ability to conduct, analyze and interpret experiments and apply experimental results to improve processes (ABET 2.c) |
| Outcome 4 | An ability to apply creativity in the design of systems, components or processes appropriate to the program objectives (ABET 2.d ) |
| Outcome 5 | An ability to function effectively on teams ( ABET 2.e ) |
| Outcome 6 | An ability to identify, analyze and solve technical problems (ABET 2.f ) |
| Outcome 7 | An ability to communicate effectively (ABET 2.g ) |
| Outcome 8 | A recognition of the need for and ability to engage in lifelong learning (ABET 2.h ) |
| Outcome 9 | An ability to understand professional, ethical and social responsibilities (ABET 2.I ) |
| Outcome 10 | A respect for diversity and a knowledge of contemporary professional, societal and global issues (ABET 2.j ) |
| Outcome 11 | A commitment to quality, timeliness and continuous improvement (ABET 2.k) |
| Outcome 12 | The application of circuit analysis and design, computer programming, associated software, analog and digital electronics, and microcomputers to the building, testing, operation and maintenance of electrical/electronic(s) systems. (ABET 8.a) |
| Outcome 13 | The application of physics or chemistry to electrical/electronic(s) circuits in a rigorous mathematical environment at or above the level of algebra and trigonometry. (ABET 8.b) |
| Outcome 14 | The ability to analyze, design and implement control systems, instrumentation systems, communication systems, power systems, or hardware and software computer systems. (ABET 8.c) |
| Outcome 15 | The ability to apply project management techniques to electrical/electronic(s)/computer systems. (ABET 8.d) |
| Outcome 16 | The ability to utilize statistics/ probability, transform methods, discrete mathematics, or applied differential equations in support of electrical/electronic(s)/computer systems and networks. (ABET 8.e) |

## 4 Computer Engineering Technology Focus Area

The EET program plans to develop a Computer Engineering Technology program in addition to current Electrical Engineering Technology program. The current EET program offers only three courses in Computer Engineering Technology area as follows:

- Digital Electronics and Microprocessor (EET2141)
- Microcomputer Interfacing (EET4141)
- Programming in C++ (EET 2241)

More courses need to be added to the curriculum to create Computer Engineering Technology Focus area. The CpET curriculum will enjoy the addition of five new technical courses to the core

of EET. The new focus area will be structured in 127 credit hour similar to the current EET degree requirements. The CpET focus area will be allocated twenty-six (26) hours out of the sixty-eight (68) Electrical Engineering Technology major which represents the core of the EET and include six hours of capstone senior project implemented in two semesters. Appendix A details the description of each individual new course.

Table 2 shows the CpET required courses detailing the number of credit hours per each class, the number of weekly hours meeting for both class and lab.

**Table 2: CpET Required Courses**

| Course | Title | Credit Hours | Weekly Lecture | Weekly Lab |
|---|---|---|---|---|
| EET2141 | Digital Electronics and Microprocessor | 4 | 3 | 3 |
| EET2241 | Programming in C++ | 3 | 2 | 2 |
| EET2142 | Digital Design and Modeling using VHDL | 3 | 2 | 2 |
| EET 2412 | Data Communications | 2 | 2 | 0 |
| EET 3141 | Computer Architecture | 4 | 3 | 3 |
| EET 3142 | Operating Systems | 3 | 2 | 3 |
| EET 3143 | Topics in programmable logic devices | 3 | 2 | 3 |
| EET4141 | Microcomputer Interfacing | 4 | 3 | 3 |

In addition to the required courses of the CpET focus area, a list of new CpET elective courses are also added. Table 3 shows the list of the CpET elective courses.

**Table 3: CpET Elective Courses**

| Course | Title | Credit Hours | Weekly Lecture | Weekly Lab |
|---|---|---|---|---|
| EET 4146 | Functional Verifications of Hardware Design | 3 | 2 | 3 |
| EET 4144 | Real-Time Robotics Systems | 4 | 3 | 3 |
| EET 4142 | Digital Signal Processing & Applications | 3 | 2 | 3 |
| EET4145 | VLSI Circuit Design | 3 | 2 | 3 |

In addition to the new CpET electives, student can also choose from the current EET Power and Industrial control technical elective courses which include courses in:

- Advanced Programmable Controllers
- Instrumentation
- Wireless Communication

Also, Students are encouraged to choose courses from Computer Networks and System Administration program courses as a technical elective, courses cover topics in:

- Network/Systems Engineering
- Systems and Network Security
- VoIP Engineering
- Network/Systems Administration
- Technical Operations Management

CpET students will choose up to 12 credit hours from the CpET electives, EET power and Industrial Control electives, and Computer Networks and System Administration.

## 5 Reconfigurable Computing Laboratory

The EET program has identified current needs for updating the existing labs to enhance and strengthen the current EET curriculum. Also, new labs are added as a result of the new Computer Engineering Technology focus area. The New Re-Configurable Computing lab is needed for the new Computer Engineering Technology Program. The lab is equipped with ten Altera's Development and Education Board. The Altera® Development and Education (DE2) board provides an ideal vehicle for learning about digital logic, computer organization, and FPGA Design. Featuring an Altera Cyclone® II FPGA, the DE2 board offers state-of-the-art technology suitable for our laboratory use. The new re-configurable lab will serve the following new courses:

- Digital Design and Modeling using VHDL – EET2142
- Computer Architecture – EET3141
- Topics in programmable logic devices – EET3143
- Functional Verifications of Hardware Design – EET 4146
- Digital Signal Processing & Applications - EET 4142

## 6 Conclusion

The electrical engineering technology program as part of SoT needs to continue improving the curriculum by introducing new concentration areas in addition to current focus of power and industrial control; this will widen the scope of the current EET program. The objectives of this paper were to present the new Computer Engineering Technology as a new focus area in the EET program. The new Computer Engineering Technology focus area prepares students for careers in hardware design, microcontroller applications and FPGA design. It is anticipated that the job outlook for the computer engineering technology graduates will continue to grow, this will make the computer engineering technology focus area at SoT is a much needed program.

The first offering of the new focus area will be in fall 2008. The goals of this new focus is to give students more career options and responds to the industry needs of skilled computer engineering technologists. Initially, The Computer Engineering Technology (CpET) can be considered as a focus area within the EET program, moving forward the CpET will be evolved into stand alone program.

## *References:*


[1] http://www2.tech.purdue.edu/eet.

[2] http://www.east.asu.edu/ctas/ecet

[3] http://www.rit.edu/%7E706www/

[4] http://www.bls.gov/oco/home.htm.

[5] N. Alaraje, S. Amos and J. E. DeGroat, "A Re-Configurable SoFPGA Architecture Design – Learning Tool," *ASEE Annual Conference & Exposition (ASEE 2006)*, June 2006

[6] N. Alaraje and J. E. DeGroat, "Evolution of Re-Configurable Architectures to SoFPGA," *IEEE International Midwest Symposium on Circuits and Systems (MWSCAS 2005),* August 2005.

[7] http://www.ieeeusa.org/careers/yourcareers.html.

[8] http://www.altera.com

[9] http://www.xilinx.com

[10] http://www.latticesemi.com

[11] " Criteria for Accrediting Engineering Technology Programs," Technology Accreditation Commission, ABET, Inc., Baltimore, Maryland, 2007.


## *Appendix A:*

**Course Descriptions:**

**Digital Design and Modeling using VHDL – EET2142 (3 Cr. Hrs, 3-3-0) , Fall, Pre EET2141:**

**Course Description:** The course emphasizes on the language concepts of digital systems design using VHSIC Hardware Description Language with an emphasis on good digital design practices, and writing testbenches for design verification. Low level gate modeling techniques with varying timing details will be presented as well as structural level of abstraction for wiring predefined gate and other predefined components. The information gained can be applied to any digital design by using a top-down design approach. Students will gain valuable hands-on experience on writing efficient hardware designs using VHDL and perform high-level HDL simulations using ModelSim

**Computer Architecture – EET3141 (4 Cr. Hrs, 4-3-1) , Fall, Pre EET2141:**
**Course Description:**

The course objectives is to cover the Computer system components, instruction set design, hardwired control units, arithmetic algorithms/circuits, floating-point operations, introduction to memory and I/O interfaces.

**Programming in C++ - EET2241 (3 Cr. Hrs, 3-3-0), SP, Pre EET2141(C) :**
**Course Description:**
The course objective is to provide a classroom and laboratory environment that enables students to become proficient C++ programmers. Students are not assumed to have a background in computer programming and therefore introductory material on software engineering and program development will be presented. However, the majority of the course will be on the specifics of the C++ language.

**Data Communications – EET2412 (2 Cr. Hrs, 2-2-0):**
**Course Description:**
This course introduces the fundamentals of basic digital communications concepts and techniques. Topics include data transmission, digital communications techniques, signal encoding techniques, fiber optics communications.

**Topics in programmable logic devices – EET3143 (3 Cr. Hrs, 3-2-1) , SP, Pre EET2142 & EET3141:**
**Course Descriptions:**

The course emphasizes on the concept of design, simulate and implement large scale digital systems which incorporate digital devices at all complexity levels. The students will learn to use large scale, digital system simulation tools.

**Digital Signal Processing Application – EET4142 (3 Cr. Hrs, 3-2-1), SP, Pre EET4141, EET3367:**
**Course Descriptions:**
The basic objective of this course is to provide students with knowledge in architecture, instruction set and hardware and software development tools associated with a fixed point general purpose DSP, Also, covers basic fundamentals of principles associated with Discrete time signals such as waveform generation, FIR, IIR digital filtering, and DFT- and FFT. Applications of DSP in control of
electric drives and power electronic devices.

**Functional Verification of Hardware Design – EET4146 (3 Cr. Hrs, 3-3-0) , Fall, Pre EET4143 (alternate):**
**Course Descriptions:**

This course is about the techniques for verification of hardware designs; writing testbenches, verifications of increasingly complex hardware system, circuit designs provided by industry using simulation environments used in industry.

**Operating system Concepts – EET3142 (3 Cr. Hrs, 3-2-1) , SP, Pre EET3141, EET2241 (alternate):**
**Course Descriptions:**

This course is about the operating system concepts: memory management, process management, and file management; sample operating systems

**Real-Time Robotics Systems – EET4144 (4 Cr. Hrs, 4-3-1) , SP, Pre EET4141, EET2220 (alternate):**
**Course Descriptions:**

This course covers the components of a Robot System, types, electronic system components, and analog-digital conversion; error analysis, hardware and software.

**VLSI Circuits Design – EET4145 (3 Cr. Hrs, 3-3-0) , Fall, Pre EET2220 (alternate):**
**Course Descriptions:**

This course covers VLSI design methodology; specification of VLSI circuits at various levels of abstraction; design, layout, and computer simulation of circuits; high-level synthesis; design projects.