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## Educational Policies Committee Program Proposal, College of Engineering, October 26, 2006 – Master of Science in Computer Engineering

Utah State University

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AGENDA  
MEETING OF THE  
UTAH STATE BOARD OF REGENTS

October 26, 2006

**Utah State Board of Regents  
Office of the Commissioner of Higher Education  
Board of Regents Building, The Gateway  
60 South 400 West  
Salt Lake City, Utah 84101-1284**

October 18, 2006

**MEMORANDUM**

TO: State Board of Regents

FROM: Richard E. Kendell

SUBJECT: Utah State University – Master of Science Degree in Computer Engineering, Effective Spring Semester 2007 – Action Item

Issue

Officials at Utah State University (USU) request approval to offer the Master of Science degree in Computer Engineering, effective Spring Semester 2007. The USU Board of Trustees approved this proposed program on May 26, 2006. The Program Review Committee approved the Letter of Intent on August 3, 2006 and directed the institution to move forward with a full proposal.

Background

In 1997, recognizing the trends in Computer Engineering, the Department of Electrical Engineering at USU added a bachelor's degree in Computer Engineering and changed its name to the Department of Electrical and Computer Engineering.

Since the program was approved, the program has grown to where one-third of BS graduates in the department are in Computer Engineering. Graduates in Computer Engineering wanting to continue for graduate work have been required to go to other institutions (often out-of-state) because the graduate curriculum and research opportunities were not available at USU. Creating a masters program in Computer Engineering will allow graduates to pursue advanced degrees at USU and provide graduate students for research projects developed by faculty.

The original Computer Engineering faculty members were mostly senior faculty with few research projects. With the help of the Governor's Engineering Initiative, the Computer Engineering program has grown within the department. Three of original faculty members have retired. The retired faculty

members have been replaced with three new Assistant Professors. The department has also added a USTAR Professor in Computer Engineering, with a fifth position in the search phase. With this increase in faculty positions comes an increase in research in Computer Engineering.

#### Policy Issues

USHE institutions have reviewed the proposal and have expressed no objections to the approval of the proposed degree. However, a question was raised concerning the projections about the growth of the graduate program due to the approval of the new degree.

Many universities have computer engineering undergraduate degrees but only offer EE and CS graduate degrees. Students with undergrad computer engineering degrees usually go into one or the other of EE and CS for MS and Ph.D. degrees. Most of the students who go into the new MS in Computer Engineering degree may be ones who would have otherwise been in their MSEE or MSCS programs. Therefore, the new MS in Computer Engineering may not draw as many students as they project.

USU is confident that the student demand is sufficient to support the new program as well as the existing programs.

#### Commissioner's Recommendation

The Commissioner recommends that the Regents approve the Request to Offer a Master of Science Degree in Computer Engineering at Utah State University, effective Spring, 2007.

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Richard E. Kendell, Commissioner

REK/GW  
Attachment

Academic, Applied Technology and Student Success Committee

Action Item

Request to Offer a Master of Science Degree in Computer Engineering Effective Spring 2007.

Utah State University

Prepared for  
Richard E. Kendell  
By  
Gary Wixom

October 18, 2006

## SECTION I: The Request

Utah State University requests approval to offer the Master of Science degree in Computer Engineering effective Spring Semester 2007. The USU Board of Trustees approved this program on May 26, 2006. The Program Review Committee of the Board of Regents authorized this proposal on August 3, 2006. If approved, the new degree programs will be effective Spring Semester 2007.

## SECTION II: Program Description

The proposed MS program will require at least 30 credit hours beyond the bachelor's degree.

The **MS Degree** will have two options, namely, research-based and design-based.

**MS Degree (plan A) Requirements:** The MS (plan A) degree is based on current research and a formal thesis. It is designed to prepare graduates for entering a PhD program or performing research in industry or government labs. It consists of core courses (5000-, 6000-, and 7000-level) in Computer Engineering, technical electives, and a research project. The following is required:

1. At least 12 credits are required (two sequences) of core Computer Engineering courses.
2. At least six credits are required (one sequence) of technical electives in CE, EE, or CS.
3. At least six credits of Thesis Research (ECE 6970).
4. At least five credits are required of electives (6000- or 7000-level) in CE, EE, CS, or other related technical areas.
5. At least one credit is required of Computer Engineering Colloquium (ECE 6810).

Note: Only three 5000-level courses will count toward the degree.

**MS Degree (plan B) Requirements:** The MS (plan B) degree is based on engineering design and a formal design project report. It is designed to prepare graduates for employment requiring advanced design in industry. It consists of core courses (5000-, 6000-, and 7000-level) in Computer Engineering, technical electives, and a design project.

1. At least 12 credits is required (two sequences) of core Computer Engineering courses.
2. At least six credits is required (one sequence) of technical electives in CE, EE, or CS.
3. At least three credits are required of Thesis Research (ECE 6970).
4. At least three credits are required of Design Project (ECE 6950).
5. At least five credits are required of electives (6000- or 7000-level) in CE, EE, CS, or other related technical areas.
6. At least one credit is required of Computer Engineering Colloquium (ECE 6810).

Note: Only three 5000-level courses will count toward the degree.

### Purpose of Degree

The new degree program will provide undergraduate students in Computer Engineering programs an opportunity to continue their studies at the graduate level. It is expected that students completing this degree program will be employed by industry and research organizations requiring a master's degree for advanced design and technical managerial positions. Graduates from this program are also expected to be

potential applicants to doctoral programs.

### **Institutional Readiness**

The new degree program will be administered by the Department of Electrical and Computer Engineering, which has in place the administrative structure necessary to manage the program. A committee oversees the graduate programs and a full-time secretary assigned to the graduate program.

### **Faculty**

Three additional faculty (in addition to the five required for the BS program) are needed for the new master's program. With the Governor's Engineering Initiative, two of the three have been hired and the third is in the search process. The University is currently searching for a computer engineering faculty member in the area of VLSI design, computer architecture or embedded systems. The advertisement is already on the department Website and will appear in the November issue of the IEEE Spectrum. The starting date will be August 2007.

All eight faculty members will be full-time, one of whom will be non-tenure track. In addition, two Emeritus Professors are teaching half time. (See Appendix C for a list of faculty.)

All of the current computer engineering faculty members will support the B.S. program in computer engineering and will support the students and programs including the computer engineering emphasis area in the current MS and PhD programs in Electrical Engineering. With recent hires and the impending new hire, USU has a very strong faculty in computer engineering. Many of the faculty are Principal Investigator (PI) or Co-PI on external research grants/contracts. A summary is given below.

- Paul Israelson: PI/Co-PI on over \$500K of external funding
- Scott Budge: PI/Co-PI on over \$500K of external funding
- Aravind Dasu: PI on over \$300K of external funding
- Krishna Shenai: PI on over \$750K of USTAR funding

The computer engineering faculty is composed of effective teachers and successful researchers. It is the strongest computer engineering faculty that USU has ever had. The ECE department has strong graduate programs in electrical engineering with over 100 full time graduate students. The addition of the MS program in Computer Engineering will further enhance the strength of the department. As the only MS program in Computer Engineering in the State of Utah, USU will serve to fill a void in the state. With this program, USU hopes to educate future computer engineers to serve the state and nation.

### **Staff**

Additional staff will not be required. The current resources within the Department of Electrical and Computer Engineering will be able to accommodate the new programs.

## Library and Information Resources

The major library resource needed for the new program is the IEEE Xplore database, which has recently been acquired by the library. The acquisition gives USU access to all IEEE journals, magazines, and conference proceedings.

## Admission Requirements

Applicants with a bachelor's degree in Electrical Engineering, Computer Engineering, or Computer Science from an ABET-accredited program and a 3.1 GPA or better can generally be admitted without restriction. Additional coursework in computer engineering fundamentals may be required in individual cases. Students must take the general GRE exam; however, the subject GRE is not required. All graduate students are expected to have a working knowledge of a computer language (preferably C or C++).

## Student Advisement

The mechanics of admission to the programs and fulfilling program requirements are handled by the department's full-time graduate secretary. As students are admitted into the program, they are assigned a temporary faculty advisor who guides them on which courses to take the first semester. During the first semester, students select a graduate committee and a major professor who advise them throughout the rest of their program.

## Justification for Number of Credits

The number of credits required for this program (30) is the same as the currently offered Master of Science in Electrical Engineering and complies with Regent's guidelines.

## External Review and Accreditation

As with the current MS program, there will be no accreditation sought for the proposed program.

## Projected Enrollment

Approximately one-third of Electrical Engineering graduating BS students remain at USU for their master's degree. If this were to hold true for CE students, the following is the expected enrollment. Note that the faculty members (except for one) are already in place, so the student/faculty ratio increases.

	<u>Enrollment</u>	<u>Student/Faculty</u>
2006	10	1.43
2007	15	1.88
2008	20	2.5
2009	25	3.13
2010	30	3.75

## Expansion of Existing Program

Year	2000/2001	2001/2002	2002/2003	2003/2004	2004/2005
Students in Communication pre-major	33	125	211	223	226

## SECTION III: Need

### Program Need

In 1997, recognizing the trends in Computer Engineering, the Department of Electrical Engineering at USU added a bachelor's degree in Computer Engineering and changed its name to the Department of Electrical and Computer Engineering. The program has grown such that approximately one-third of BS graduates are in Computer Engineering. The five original Computer Engineering faculty members were mostly senior faculty with few research projects. Graduates in Computer Engineering wanting to continue for graduate work were required to go to other institutions (often out-of-state) because the graduate curriculum and research opportunities were not available at USU. With the help of the Governor's Engineering Initiative, the Computer Engineering program has grown within the department. Three of the five original faculty members have retired. They have been replaced with three new Assistant Professors. The department has also added a USTAR Professor in Computer Engineering, with a fifth position in the search phase. With this increase in faculty positions comes an increase in research in Computer Engineering. Creating a masters program in Computer Engineering will allow graduates to pursue advanced degrees at USU and provide graduate students for research projects being developed by the new faculty.

### Labor Market Demand

A recent article in Money Magazine ([money.cnn.com](http://money.cnn.com)), entitled *Best Jobs in America* ranked 166 jobs. Software Engineering (another name for Computer Engineering) was listed as the top career in America. The data below lists the top ten jobs with job growth and average pay:

<u>Rank</u>	<u>Career</u>	<u>Job Growth</u>	<u>Average Pay</u>
1.	Software engineer	46.07%	\$80,427
2.	College professor	31.39%	\$81,491
3.	Financial advisor	25.92%	\$122,462
4.	Human resources manager	23.47%	\$73,731
5.	Physician assistant	49.65%	\$75,117
6.	Market research analyst	20.19%	\$82,317
7.	Computer/IT analyst	36.10%	\$83,427
8.	Real estate appraiser	22.78%	\$66,216
9.	Pharmacist	24.57%	\$91,998
10.	Psychologist	19.14%	\$66,359

This program will help meet the need for high-paying technical jobs in the State of Utah as stated in the governor's Engineering Initiative. It is expected that the demand for Computer Engineering graduates will continue to increase within the state as well as within the US. Although no major market demand change is

expected, the impact on the program from a change in demand will be minimal, since the faculty associated with this program will continue to participate in the BS Computer Engineering program and the graduate Electrical Engineering programs.

### **Student Demand**

Undergraduate Computer Engineering students have become a significant fraction of the ECE Department. Students in this program have expressed a desire to continue in a graduate Computer Engineering program after graduation. The number of students in the BS Computer Engineering program has been strong at approximately 100, which represents about 1/3 of the total undergraduate student population in ECE. As improved recruitment and policy changes in the University take effect, the department expects to see an increase in demand for the CE Degree.

### **Similar Programs**

The School of Computing and the Department of Electrical and Computer Engineering at the University of Utah jointly offer a Bachelor of Science degree in Computer Engineering. The program is administered by the Computer Engineering Committee, which consists of faculty members from both departments. The University of Utah offers graduate degrees in Electrical Engineering and Computer Science, but not in Computer Engineering. Within the state, but not part of USHE, the Department of Electrical and Computer Engineering at Brigham Young University offers BS degrees in Electrical Engineering and in Computer Engineering. Their MS and PhD degrees are in Electrical Engineering, but students can emphasize computer engineering.

### **Collaboration with and Impact on Other USHE Institutions**

Richard Brown, Dean of the College of Engineering at the University of Utah has expressed support for the MS degree in Computer Engineering at USU. It should not conflict with their current program. In fact, there has been some discussion in having USU and UofU team together in providing extension opportunities for programs such as at Hill Air Force Base.

### **Benefits**

The proposed program will allow students interested in Computer Engineering at the graduate level to continue their education at USU. Significantly, these graduate students will enhance the ability of new faculty in Computer Engineering to attract and perform research within their areas of specialization.

The USHE will also benefit from this program because it will be the first graduate Computer Engineering program within the system, with the potential for attracting students to USU from outside the state, and retaining students from within the USHE who would otherwise seek educational opportunities in Computer Engineering elsewhere.

## **Consistency with Institutional Mission**

The mission of Utah State University is to be one of the nation's premier student-centered land grant and space-grant universities by fostering the principle that academics come first, by cultivating diversity of thought and culture, and by serving the public through learning, discovery, and engagement.

The master's degree in Computer Engineering will support the University Mission Statement in the following ways:

1. The department becomes more student-centered by providing a program to meet the needs of the students.
2. The master's program will improve academics in Computer Engineering by fostering research in the forefront of the field.
3. The master's program will serve the public by application of the research produced.

## **SECTION IV**

### **Program and Student Assessment**

The major goal for the program is to graduate MS students who have an interest in Computer Engineering and who are prepared to meet the needs of industry and academia for Computer Engineers by having learned modern skills and tools of Computer Engineering. Attainment of this goal will be measured by the placement rate of graduates within industrial, research laboratories, and PhD programs.

### **Student Assessment**

The standard of performance that all students must obtain is a B- or better in all classes required for the degree. In addition, all students must satisfactorily pass a defense of their MS thesis or project. These standards are already expected for the existing MS degree program in Electrical Engineering.

## SECTION V

### Budget

The following budget will be needed for the three additional faculty members.

	<u>2006</u>	<u>2007</u>	<u>2008</u>	<u>2009</u>	<u>2010</u>
Salaries and Wages:	204.0k	209.2k	214.4k	219.8k	225.3k
Benefits:	88.8k	92.0k	95.4k	98.9k	102.5k
Current Expense:	18.0k	19.5k	21.0k	22.5k	24.0k
Library:	0k	0k	0k	0k	0k
Equipment:	30.0k	30.0k	15.0k	15.0k	15.0k
Travel:	6.0k	7.5k	9.0k	9.0k	9.0k
TOTAL:	338.8k	358.2k	354.8k	365.2k	375.8k

### Funding Sources

Funding for this program has already been allocated by the Governor's Engineering Initiative program. Funding is currently in place, so additional funding is not required.

### Reallocation

No current reallocation of program funds is planned.

### Impact on Existing Budgets

Other costs, such as secretarial help, will be absorbed as part of the current department budget. Research assistantships are covered from research grants. Teaching assistantships are covered from department lab fees.



including pipelining and superscalar techniques, multiprocessors, vector, SIMD, and MIMD computers. . Includes a class project and presentation.

ECE 6810      Computer Engineering Colloquium                      0.5

Weekly seminars or colloquia. Students are normally required to enroll for two semesters.

ECE 7480      Systems-on-a-chip Design                                      3

This course focuses on integrating information processing, storage, communication, power management, sensing and control electronics on a single-chip platform for emerging low-power electronics applications in information and bio technologies. The course includes projects performed in collaboration with leading industries utilizing advanced EDA tools and design strategies.

ECE 7620      Advanced Topics in Computer Networking                      3

Advanced topics in computer networking, including wireless and ad-hoc networks, advanced and emerging protocols, and high-performance routing techniques.

**All Program Courses:**

VLSI Design:

ECE 5530	Digital System Design	3
ECE 6430	Applied CMOS Electronics	3
ECE 6440	Reconfigurable Computing	3
ECE 6450	Advanced Semi-conductor Devices	3
ECE 6460	Digital VLSI System Design I	3
ECE 6470	Digital VLSI System Design II	3
ECE 6480	Mixed Signal VLSI	3
ECE 7480	Systems-on-a-chip Design	3

Computer Architecture:

ECE 5750	High-Perf. Microprocessor Architecture	3
ECE 6770	Parallel Processing	3
ECE 7760	Advanced Topics in Distributed Systems	3

Computer Networking

ECE 6600	Computer Networking I	3
ECE 7610	Computer Networking II	4
ECE 7620	Advanced Topics in Computer Networking	3

Embedded Systems

ECE 5640	Real-Time Processors	4
ECE 5770	Microcomputer Interfacing	4
ECE 5780	Real-Time Systems	4
ECE 6730	Embedded Software	3
ECE 6740	Model Integrated Computing	3
ECE 7770	Advanced Topics in Real-Time Systems	3

Concurrent Systems

ECE 5740	Concurrent Programming	3
ECE 6750	Concurrent Systems Engineering I	3
ECE 6760	Fault-Tolerant Systems	3
ECE 6780	Device Drivers	3
ECE 7710	Concurrent Systems Engineering II	3
Colloquium		
ECE 6810	Computer Engineering Colloquium	0.5

**Appendix B**  
**Program Schedule**

**Master of Science (MS-plan A)**

<u>Fall 1</u>		<u>Spring 1</u>		<u>Summer 1</u>		<u>Fall 2</u>	
ECE 6810	0.5	ECE 6810	0.5	ECE 6970	<u>6</u>	Elective 3	
CE core 1	3	CE core 1	3		6	Elective <u>3</u>	6
CE core 2	3	CE core 2	3				
Tech Elect 1	<u>3</u>	Tech Elect 1	<u>3</u>				
	9.5		9.5				

**Master of Science (MS-plan B)**

<u>Fall 1</u>		<u>Spring 1</u>		<u>Summer 1</u>		<u>Fall 2</u>	
ECE 6810	0.5	ECE 6810	0.5	ECE 6950	3	Elective 3	
CE core 1	3	CE core 1	3	ECE 6970	<u>3</u>	Elective <u>3</u>	6
CE core 2	3	CE core 2	3		6		
Tech Elect 1	<u>3</u>	Tech Elect 1	<u>3</u>				
	9.5		9.5				

## Appendix C

### Faculty

#### Existing Faculty

- 1) Alan W. Shaw, Professor Emeritus, PhD, Stanford University, 1960 (VLSI design): 0.5 FTE
- 2) Paul A. Wheeler, Associate Professor, PhD, BYU, 1978 (Microprocessor Systems): 1.0 FTE
- 3) Paul Israelson, Research Associate Professor, MS, 1988, Utah State University (Digital Systems Design): 0.66 FTE teaching.
- 4) Scott Budge, Associate Professor, PhD, BYU, 1990 (Digital Signal Processors): 1.0 FTE
- 5) Aravind Dasu, Assistant Professor, PhD, Arizona State, 2004 (computer architecture): 1.0 FTE
- 6) Chris Winstead, Assistant Professor, PhD, University of Alberta, 2004 (analog VLSI): 1.0 FTE

#### Recent Hires

- 7) Brandon Eames, Assistant Professor, PhD, Vanderbilt, 2005 (embedded systems): 1.0 FTE (Hired 8/05).
- 8) Krishna Shenai, Professor, PhD, Stanford, 1986 (mixed signal circuit design): 1.0 FTE (Hired 5/06).
- 9) Don Cripps, Principal Lecturer, PhD, Utah State University], 2004 (Microprocessor based controls, digital design): 1.0 FTE (Hired effective 1/07).