SPECIAL REPORT

OF THE

GRADUATE COUNCIL

concerning

CREATION OF A CERTIFICATE PROGRAM:
INTERNET OF THINGS
(#4435)

Presented at the
776th Regular Meeting of the Faculty Senate
March 8, 2018

COUNCIL MEMBERSHIP

GRADUATE COUNCIL


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The Graduate Council recommends approval of this proposal.

Briefly describe the certificate.

The Internet of Things certificate is meant to provide a coherent foundation for graduate students interested in learning how discrete electronic components can be interconnected to form networks. This certificate covers issues related to the implementation of monitoring and control systems, data analysis, and security for interconnected devices.

The Electrical and Computer Engineering (ECE) Department would like to offer a graduate certificate in this area consisting of five courses from its graduate curriculum. To receive the certificate, students would take the following required and elective courses:
Required courses

- ECE688F: Graduate Project (1st semester)
- ECE688P: Graduate Project (2nd semester)

Elective courses (students choose 3 out of 6 courses)

- ECE510: Foundations of Computer Engineering
- ECE678: Data Analytics
- ECE671: Computer Networks
- ECE674: Green Computing
- ECE644: Trustworthy Computing
- ECE670: Advanced System Software

To receive the Internet of Things (IoT) certificate, students must develop and complete a project in IoT as part of the ECE688F/P sequence. All courses listed are three credits.

Current ECE Masters of Science (MS) students and non-matriculating students may apply for the certificate program. Non-matriculating students should have sufficient technical background, as determined by the ECE Graduate Program Director, to join the certificate program. This certificate will be transitional. All credits received as part of the certificate can be applied to an MS degree in ECE. Acceptance into the certificate program does not automatically qualify a student for the ECE MS program, although the student may attempt to join such a program at any time. If a student joins the ECE MS program after completing the certificate, all 15 credits can be applied to the ECE MS degree. Completion of the certificate does not imply admission to the University in a specific academic program. All courses associated with the certificate will be taught frequently. Students will be able to complete the certificate within a reasonable time period.

Provide a brief overview of the process for developing this certificate.

The proposal has been developed in consultation with the ECE Department Head and several other ECE faculty members. The proposal has been presented to the ECE faculty. The faculty have voted to proceed with the certificate proposal.

Purpose and Goals

Describe the certificate's purpose and the particular knowledge and skills that will be acquired by participating students.

By completing the courses associated with this certificate, students will become familiar with the state-of-the-art in the design, testing, and use of interconnected systems. The volume of everyday devices connected to the Internet has expanded exponentially over the past 10 years. Systems ranging from household appliances to automobiles to smart phones are linked, allowing for immediate access to data and the ability of users to control many aspects of their living space. Expertise in IoT has become crucial for many jobs and employers often look for students with
knowledge of how to design, build, and test complex IoT systems. The courses included in this certificate provide a solid basis of knowledge in these areas.

UMass Amherst does not currently have a similar graduate certificate offering in this technical area.

Resources

If this proposal requires no additional resources, say so and briefly explain why. If this proposal requires additional resources, explain how they will be paid for. For proposals involving instruction, indicate how many new enrollments are expected and whether the courses have room to accommodate them.

All eight courses associated with this certificate are already offered by the ECE department. Formal course proposals have been submitted for ECE678, ECE674, and ECE510. It is expected that the enrollment in each course will remain roughly the same for on-campus students. If the courses are offered via Continuing and Professional Education (CPE), an increase of 10 to 15 students per class could be expected. The income from these students would defer additional expenses associated with the program. The courses are also currently offered as part of the UMass Field Degree (Shorelight) program MS in ECE. The availability of a certificate that uses the courses will not affect enrollment since the courses are already needed for the MS degree.

Curriculum

Please describe the curriculum for this certificate, listing all required courses and possible electives, any prerequisites or GPA requirements, the recommended order or coursework and any other pertinent information. You may attach additional materials related to the curriculum at the end of this section.

To receive the certificate, students would take the following required and elective courses:

Required courses

- ECE688F: Graduate Project (1st semester)
- ECE688P: Graduate Project (2nd semester)

Elective courses (students choose 3 out of 6 courses)

- ECE510: Foundations of Computer Engineering
- ECE678: Data Analytics
- ECE671: Computer Networks
- ECE674: Green Computing
- ECE644: Trustworthy Computing
- ECE670: Advanced System Software

To receive the Internet of Things (IoT) certificate, students must develop and complete a project in IoT as part of the ECE688F/P sequence. In ECE688F and ECE688P students work in small teams of two or three students. Each team produces one system in their project. However, each
student is responsible for an aspect or a component of the overall system. Thus, each student’s contribution and the quality of that contribution will be assessed separately.

All courses listed are three credits.

ECE678 requires prior student knowledge in probability and linear algebra. Other courses do not contain prerequisites. The elective courses can be taken in any order although it is recommended that if a student chooses to take ECE510, this course should be taken first. ECE688F precedes ECE688P. Students may enroll in the certificate courses if they have been accepted into the Internet of Things certificate program at the discretion of the ECE Graduate Program Director. Per UMass regulations, students must achieve a 3.0 GPA in the certificate courses to receive a certificate.

*Explain how these courses represent a coherent course of study.*

The courses provide a solid basis of state-of-the-art knowledge in internet of things. ECE510 provides appropriate background in advanced computer engineering fundamentals for students so that students may have a solid foundation for the remaining four certificate courses. ECE678 examines practical issues regarding analyzing data from distributed sensors. ECE644 provides details on network security. ECE671 examines mathematical, protocol, and physical limitations of computer networks. ECE674 introduces the concept of using renewable energy to operate distributed computing devices. ECE670 examines programming techniques for large software systems. Finally, ECE688F/P provide the students an opportunity to work in a small group to complete a hands-on project related to the internet of things. The students also learn technical presentation and writing skills as part of the project courses.

*Describe how there is a clear educational objective that can be achieved in an efficient and well-defined manner.*

The courses provide a broad spectrum of background in internet of things. Upon completion of the certificate, students will have a clear understanding of the important issues in internet of things and will be qualified to seek employment in this area. Each course covers a different aspect of internet of things. ECE510 is provided as an elective option for students that feel that they need additional background in computer engineering when starting the certificate program.

*Explain how the course sequence offers a clear objective at the appropriate educational level.*

ECE510 provides foundations for students who feel that they need additional computer engineering background. The ECE688F/P sequence offers an opportunity for students to work on an involved project in a team setting. The other courses can be taken at any time during the program. The collection of these courses offers the student a strong foundation in internet of things.
Describe the perceived need for this certificate.

By completing the courses associated with this certificate, students will become familiar with the state-of-the-art in the design, testing, and use of interconnected systems. The volume of everyday devices connected to the Internet has expanded exponentially over the past 10 years. Systems ranging from household appliances to automobiles to smart phones are linked, allowing for immediate access to data and the ability of users to control many aspects of their living space. Expertise in IoT has become crucial for many jobs and employers often look for students with knowledge of how to design, build, and test complex IoT systems. The courses included in this certificate provide a solid basis of knowledge in these areas.

If the courses that comprise the certificate have been or currently are being offered, describe their schedule of availability. If the certificate is comprised of new courses, describe their planned availability.

ECE644, ECE688F, ECE671, ECE688P and ECE670 are currently offered every year. ECE674 and ECE678 have been offered every year for the past several years as seminar courses ECE697GC and ECE697DA, respectively. ECE510 is being offered for the first time in Fall 2017 as a seminar course (ECE697CE). It is expected that all courses associated with the new certificate will be offered every one to two years to allow students to complete the certificate in a timely fashion.

If the certificate requires or includes courses from outside the sponsoring department, provide evidence of agreement(s) with the unit(s) offering those courses. You may attach any memoranda of understanding below.

All courses will be offered by the ECE department

If applicable, please attach any memoranda of understanding from other departments or colleges below.

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If the requirements for this certificate overlap with those of another certificate or a degree program, describe that overlap.

(Note that if a student who has completed a certificate seeks clearance for a degree program that overlaps with that certificate program, the Registrar will note on the transcript that the certificate has been superseded by the degree.)

Students that complete the certificate will be able to use the course credits to complete a Masters of Science (MS) degree in ECE if they are accepted into the MS program. Three other ECE graduate certificate proposals (Computer Networking, Computer Systems Security, and Embedded Systems) also include ECE688F/P and ECE510. To complete an Internet of Things certificate, students will need to complete a project specifically in the IoT area in ECE688F/P. The proposed Computer Systems Security certificate includes ECE644 as an elective. The proposed Computer Networking certificate includes ECE644 and ECE671 as electives.
If a student receives an Internet of Things certificate, the student will not be eligible to receive one of the following certificates (Computer Systems Security, Embedded Systems, and Computer Networking).

*What type of student is allowed to participate in this certificate program? (E.g., matriculated UMass students, non-matriculated CPE students, Five College students, graduate students, students in a specific degree program, etc.)*

The following types of students are eligible for the certificate program: matriculated UMass ECE graduate students, non-matriculated UMass graduate students (e.g. CPE), and UMass Field Degree (Shorelight) ECE students.

*What role will this certificate play in relation to other departments or degree programs on campus? Certificates vary widely across campus and may represent a subset of an existing degree program, a multidisciplinary program, or an entirely free-standing area of focus.*

Students who complete the certificate program can use the credits towards an ECE MS degree. Students in an ECE MS program may also complete a certificate if they are accepted into the certificate program.

*Is this a transitional certificate program? (Transitional certificate programs are comprised of core courses from specific degree programs and may act as stepping stones into those programs. If a student who has completed a transitional certificate matriculates to the University and completes the degree program associated with that certificate, the transcript will note that the certificate has been superseded by the degree.)*

Yes
Comments: The credits can be used towards an ECE MS degree

*If applicable, please attach any additional material relating to the certificate (such as requirement checksheets for students, etc.) below.*

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**MOTION:** That the Faculty Senate approve the Creation of a Certificate Program: 21-18 Internet of Things, as presented in Sen. Doc. No. 18-039.