

## **GRADUATE CERTIFICATE PROGRAM IN CYBER-PHYSICAL SYSTEMS**

### **Recommendation**

It is recommended that the Board of Governors establish a Graduate Certificate in Cyber-Physical System effective Fall 2017.

### **Background**

The deep embedding of sensing, computing, networking, and control into physical systems and processes is expected to bring about cyber-physical systems (CPS) which represent the tight integration of computation with physical processes whose behavior is defined by both cyber and physical parts of the system. As an intellectual challenge, CPS is about the intersection, not the union, of the physical and the cyber. CPS serves as a foundation for a wide range of domains such as transportation, energy grid, industrial automation, advanced manufacturing, healthcare, and public safety. Given that CPS is still at its early stage of development as a discipline, this will be the first graduate CPS education program in the State of Michigan, and no other Michigan institutions (e.g., University of Michigan and Michigan State University) have offered any graduate or undergraduate CPS programs.

### **Program Description**

Given the interdisciplinary nature of CPS and the broad CPS applications, it is essential for a CPS education program to provide comprehensive treatment of the involved scientific and engineering fundamentals and to offer choices of the scope, depth, and types of learning activities. To this end, we propose a three-tiered approach to CPS education. At the CPS core, we cover fundamental building blocks of CPS such as sensing, embedded computing and networking, control systems, security, and data science and engineering. Building upon the CPS core, we offer diversification options that enable the understanding of domain-specific CPS topics in areas such as connected and automated vehicles, intelligent transportation systems, smart energy grid, industrial automation, and smart and connected health. The diversification training-materials/courses need to offer options of high-level overviews and in-depth treatments for satisfying the varying needs of the CPS workforce. Based on the CPS core and diversification options, we provide adventure learning activities that cultivate capabilities of applying CPS principles and techniques in practice and that offer the option of exploring the unknowns and pushing the frontiers of CPS knowledge and practice. To this end, it is important to provide seminar/capstone courses that may be jointly taught by faculty and industry partners; these courses are expected to provide participants with 1) the understanding of domain-specific challenges in the near, medium, and long terms, 2) hands-on projects of applying CPS principles and techniques to solve real-world problems, and 3) project-centered training on research skills and inter-disciplinary studies. The courses of the CPS Graduate Certificate Program (as detailed in the program proposal) will be taught by the existing faculty members of the College of Engineering who have been conducting cutting-edge research in various aspects of cyber-physical systems.

Submitted by: Keith E. Whitfield, Provost

### **Admission Requirements**

Students must hold an M.S. or Ph.D. in an engineering or engineering-related discipline, or be admitted into an M.S. or Ph.D. degree program in the College of Engineering at Wayne State University to be admitted into the CPS Graduate Certificate Program.

### **Curriculum Requirements**

The CPS program requires each student to take the course “CSC 5260/ECE 5260: Introduction to Cyber-Physical Systems.” Then, depending on students' interests, they can choose one of the six tracks of the CPS program (Sensing, Computing and Networking, Control and Robotics, Smart Transportation, Smart Grid, and Smart Health), where they will take two intermediate-level courses and one advanced course.

### **Graduation Requirements**

To graduate from the CPS Graduate Certificate Program, a student needs to complete the courses required by the student's chosen track. In addition, the student needs to meet the following general requirements graduate certificate programs:

- Students must earn at least 12 graduate-level semester credits.
- At least one course must be at the 7000 level or higher.
- Transfer credit will not be accepted for the certificate program.
- A minimum grade point average of 3.0 must be achieved in certificate coursework.
- A student must complete the certificate program within three years.
- No more than nine semester credits taken in the CPS Graduate Certificate Program may be applied toward a graduate degree, subject to the approval of the relevant academic unit and graduate office.

### **Program Administration**

Student advising and strategic program oversight will be provided by the CPS Program Lead Team, which consists of six faculty Track Directors and a faculty Program Director. The Program Director will coordinate program-wide activities such as curriculum review and program assessment, and the Track Directors will lead activities related to the individual tracks of the CPS program.

The CPS Graduate Certificate Program is a college-wide program at the College of Engineering, and we expect graduate students from different engineering departments to enroll in the program. The admission and operational evaluation of the CPS program will be handled by the students' home departments, for instance, through the graduate advisors of the individual home departments. Departments' advisors will coordinate with the CPS Program Lead Team and the CPS Program Coordinator in managing the program.

### **Budget and Resource Requirements**

Existing College of Engineering resources have been identified and re-allocated to support the program, primarily via a natural evolution and coalescence of faculty interests in this new area.

Submitted by: Keith E. Whitfield, Provost

**Accreditation**

There are no accrediting bodies for cyber-physical systems.

**Approvals**

The proposal for the Graduate Certificate in Cyber-Physical Systems was approved by: the faculties and Chairs of the Departments of Computer Science, Electrical and Computer Engineering, and Civil and Environmental Engineering; the faculty and Dean of the College of Engineering; the Graduate Council; the Dean of the Graduate School and the Provost.