



# Northeastern University

## College of Engineering

Proposal to introduce a new MS program on “Cyber-Physical Systems”

College of Engineering  
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## **Proposal**

The College of Engineering (COE) proposes to offer a new MS program on Cyber-Physical Systems.

## **Need for a MS Program on Cyber-Physical Systems**

The NSF [1] defines cyber-physical systems (CPS) as engineered systems that are built from, and depend upon, the seamless integration of computational algorithms and physical components. CPS systems are already widely deployed and used today. Examples include cars that sense impending crashes and perform various actions to protect passengers, and medical devices that sense glucose levels and intervene to restore normal body functions. A CPS may be small and closed, such as an artificial pancreas, or large, complex, and interconnected such as a regional energy grid. In fact, as part of its exploration of CPS, NSF asked the National Academy of Sciences, Engineering and Medicine to study the topic and prepare reports examining the need for a CPS education [2].

A MS degree program in Cyber-Physical Systems has been recently announced by the University of Virginia while a MS degree in Embedded/Cyber-Physical Systems was recently initiated by UC-Irvine. Furthermore, a specialization in CPS is offered by the IIT (Illinois) and a concentration in CPS by CMU.

Cyber-Physical Systems (CPS) integrate sensing, computation, control and networking into physical objects and infrastructure, connecting them to the Internet and to each other. Thus, Cyber-Physical Systems encompasses the Internet-of-Things (IoT) as well as many other areas that integrate computation, networking, and physical processes. As a result, it is proposed that the existing IoT a concentration in the Computer Systems Engineering program become a concentration instead in the CPS MS program. As a concentration in CPS, the IoT concentration has a more natural home, should get even more visibility and attract more applications. However, whereas CPS and the IoT have a lot in common, they are not synonyms. For example, not all CPS applications require a network infrastructure

Until more concentrations are added, all students in the MS in CPS program will be automatically students in the IoT concentration, which of course already exists. No changes to this concentration (see Appendix) are being proposed at this time – except updates to the prefix codes for appropriate courses.

## **References**

- [1] National Science Foundation, “Cyber-Physical Systems,” Program Solicitation, 2016
- [2] “A 21<sup>st</sup> Century Cyber-Physical Systems Education,” National Academies Press, 2016

## Appendix: MS Degree Requirements – Internet of Things Concentration

Complete all course and requirements listed below unless otherwise indicated. Students may not register for more than 10 hours in the fall and spring terms, and 4 semester hours in each of the three summer terms. Any exceptions must be approved by the program director.

### Required Core

#### Course List

Code	Title	Hours
CSYE 6200	Concepts of Object Oriented Design	4
CSYE 6510	Fundamentals of the Internet of Things (CPS 6510)	4
CSYE 6530	Connected Devices (CPS 6530)	4
TELE 5330 and TELE 5331	Data Networking and Lab for TELE 5330	4

### Electives

Complete four of the following. A maximum of 8 semester hours of non-technical electives may be taken. Students may take elective course work outside these lists only with the prior approval of the program director. A maximum of 9 semester hours may be taken outside of the College of Engineering.

#### *Technical Electives*

#### Course List

Code	Title	Hours
CSYE 6225	Network Structures and Cloud Computing	
CSYE 6230	Operating Systems	
CSYE 7215	Foundations of Parallel, Concurrent and Multithreaded Programming	
CSYE 7374	Special Topics in Computer Systems Engineering (Internet of Things) (CPS 7374)	
CSYE 7945	Software Engineering Project (Internet of Things) (CPS 7945)	
CSYE 7978	Independent Study (Internet of Things) (CPS 7978)	

DS 5220 Supervised Machine Learning & Learning Theory  
DS 5230 Unsupervised Machine Learning & Data Mining  
EECE 5155 Wireless Sensor Networks and the Internet of Things  
EECE 7390 Computer Hardware Security  
IE 5640 Data Mining for Engineering Applications

Or

IE 7275 Data Mining in Engineering  
INFO 6101 Data Science Engineering with Python  
INFO 6105 Data Science Engineering Methods and Tools  
INFO 6150 Web Design and User Experience Engineering  
INFO 6205 Program Structures and Algorithms  
INFO 7290 Data Warehousing and Business Intelligence  
TELE 5360 Internet Protocols and Architecture

*Non-Technical Electives*

EMGT 5220 Engineering Project Management  
INFO 6640 People, Processes and Products: Ethics for Engineers  
INFO 6650 People, Problems and Patents: Basics of Intellectual Property  
INFO 6660 Business Ethics and Intellectual Property for Engineers