UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola Superior d'Enginyeries Industrial, Aeroespacial i Audiovisual de Terrassa

GUIA PENDENT D'APROVACIÓ

Descripció general

Nom de l'assignatura: **Industrial IoT and Cyber - Physical Systems**

Departament: **710**

ECTS: **3 ECTS**

Titulació:

Master's Degree in Automatic Systems And Industrial Electronics

Master's Degree in Industrial Engineering

Master's Degree in Aeronautical Engineering

Curs: **2020/2021**

Idioma: **English**

Codi: **205094**

Tipus: **Elective**

Professors

Coordinador: José Luís ROMERAL MARTÍNEZ

Altres: Miguel DELGADO PRIETO

Objectius generals del curs

This course will provide an overview of industrial internet of things and cyber-physical systems to deploy digital twins of industrial processes in the cloud. Sensor devices are applied to real machinery and processess, which are connected to the industrial IoT network. Thus, data is collected and send to a cloud-hosted system so that the data can be processed on a digital model of the industrial process, i.e., a digital twin. By this way the twin replicate on a digital dimension some characteristics of the industrial assets, offering real-time analytics and insights on how it is functioning and awaring about potential issues. In this regard, industrial plant management and control are typical cyber-phisical applications, as well as enabling augmented reality procedures over of complex industrial processes for predictive maintenance purposes.

From a very technical approach and by means of practical examples, this subject reviews the different engineering technologies related to the development of an Industrial IoT and Cyber-Physical System in practice. Including configuration of network-based communications and embedded hardware programming (Edge box, Node-Red, and other programming platforms); design and management of data-bases (InfluxDB and other data structures); and development of cloud-based analytical procedures and interfacning (machine learning, Grafana and other softwares and analytical approaches).

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Competències

Competències específiques	
Competències generals	

Crèdits: total d'hores de treball de l'estudiantat

		Dedicació	
		Hores	%
Aprenentatge directe	Grup Gran (GG)	9	12
	Grup Mitjà (GM)	-	-
	Grup Petit (GP)	18	24
Aprenentatge autònom		48	64

Continguts

Mòdul 1: Network-based communications for Industry 4.0	Dedicació: 21 hores	GG: 3 hores GP: 6 hores AA: 16 hores
Descripció	At the core of Industry 4.0 are smart sensors and devices. This technology gathers virtually infinite volumes of information about its own environment and then uses embedded intelligence to complete programmed functions before sharing the information with other systems and devices via network-based communications. This module includes: 1. Overview of network types 2. IIoT connectivity standards and industrial common protocols 3. Communication requirements assessment 4. Software based communication connector suites 5. Outlook for future communication standards in the Industry 4.0	
Activitats relacionades (*)	Laboratory report 1 – Communications Cyber-physical system project	

Mòdul 2: Edge, Fog and Cloud computing architectures	Dedicació: 21 hores	GG: 3 hores GP: 6 hores AA: 16 hores
Descripció	For many industrial companies one challenge of Industry 3.0 was the lack of data. With the deployment of smart devices and the corresponding communication networks, the problem in Industry 4.0 quickly become not the absence of data but the excess of it. This module includes: 1. Edge, fog and cloud architectures. 2. Main IT devices for each architecture: strenghts and weaknesses 3. Data bases and information flow	
Activitats relacionades (*)	Laboratory report 2 – Computigng architecture Cyber-physical system project	

Mòdul 3: Cyber-Physical Systems and Interfacing	Dedicació: 21 hores	GG: 3 hores GP: 6 hores AA: 16 hores
Descripció	The greater versatility and increasingly smaller sizes of sensing devices, communication networking and architectures, results in a new computing paradigm called cyber-physical	

	system, which represent the convergence point bewteeen the operational technology and the information technology. Thus, this module includes: 1. Basis for a technological deployment of a cyber-physical system 2. Analytical procedures for a digital twin over industrial assets 3. Remote visualization of industrial processes condition and operation
Activitats relacionades (*)	Laboratory report 3 – Analytics and interfacing Cyber-physical system project

Sistema d'avaluació

60% - Laboratory reports. After each laboratory session the students will handle a short laboratory report.
40% - Final project presentation. At the end of the course, the students will present the complete project.

Final mark = 0.2 * LR1 + 0.2 * LR2 + 0.2 * LR3 + 0.4 * P

Metodologia docent

The teaching methodology is based on a learning-by-doing approach under an active-learning framework. Thus, the learning is supported by:

- Lecture sessions
- Laboratory sessions
- Independent learning

In the lecture sessions, the lecturer will promote discussion over a practical problem to be solved in order to introduce the theoretical basis, concepts and methodologies related with the subject. The lecture sessions will be supported by presentations and simulations in software platforms. That is, following an action-based approach in which the teacher and the student continually reflect on the practice.

In the laboratory work sessions, the teacher will guide the students in the application of the theoretical concepts for the resolution of experimental assemblies, basing at all times the critical reasoning. Activities will be proposed that the students solve in the classroom and outside the classroom, in order to favor the contact and use of the basic tools necessary for the realization of an cyber-physical system. The laboratory sessions will follow a project-based-learning, in which groups of students will solve industrial problems to produce experimental results taking advantage of the required digital tools. Thus, promoting a collaborative work were the students will carry out the proposed activities, based on a common objective, in which they must collaborate actively to finalize it.

Finally, the students, autonomously, must work on the material provided by the teachers and the results of the lecture and laboratory sessions in order to assimilate and fix the concepts. Teachers will provide a study and activity monitoring plan (ATENEA).

Referencies

Bàsica	Lecture notes
Complementaria	Introducing Windows Azure for IT Professionals Mitch Tulloch; Ed. Microsoft Press (1st Edition, 25 November 2013); ISBN-13: 978-0735682887, Nancy Velásquez, Elsa Estevez and Patricia Pesado, Cloud Computing, Big Data and the Industry 4.0 Reference Architectures, Journal of Computer Science & Technology, Volume 18, Number 3, December 2018, https://journal.info.unlp.edu.ar/JCST/article/view/1151/914

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	F. Zezulka, P. Marcon, Z. Bradac, J. Arm, T. Benesl, I. Vesely, Communication Systems for Industry 4.0 and the IIoT, IFAC-PapersOnLine, Volume 51, Issue 6, 2018, Pages 150-155, ISSN 2405-8963, https://doi.org/10.1016/j.ifacol.2018.07.145 Da Costa, M.B., Dos Santos, L.M.A.L., Schaefer, J.L. et al. Industry 4.0 technologies basic network identification. Scientometrics 121, 977–994 (2019). https://doi-org.recursos.biblioteca.upc.edu/10.1007/s11192-019-03216-7 Monostori, B. Kádár, T. Bauernhansl, S. Kondoh, S. Kumara, G. Reinhart, O. Sauer, G. Schuh, W. Sihn, K. Ueda, Cyber-physical systems in manufacturing, CIRP Annals, Volume 65, Issue 2, 2016, Pages 621-641, ISSN 0007-8506, https://doi.org/10.1016/j.cirp.2016.06.005
Altres recursos	https://www.se.com/es/es/ https://azure.microsoft.com/es-es