

Course **Specifications**

Valid as from the academic year 2024-2025

Internet of Things (E019170)

Course size	(nominal values; actual values	may depend on pro	igramme)		
Credits 6.0	Study time 180 h				
Course offerings and	teaching methods in academic yea	r 2024-2025			
A (semester 1)	English	Gent	in	independent work	
			le	cture	
			рі	practical	
			Se	seminar	
			gi	group work	
Lecturers in academic	c year 2024-2025				
Hoebeke, Jeroer	1		TW05	lecturer-in-c	harge
De Poorter, Eli			TW05	co-lecturer	
Offered in the following programmes in 2024-2025				crdts	offering
Master of Scienc Technology)	e in Electrical Engineering (main sul	oject Communicatic	on and Informat	ion 6	Α
Master of Science	e in Computer Science			6	А
Master of Science	e in Computer Science Engineering			6	А
Master of Science	e in Computer Science Engineering			6	А
Master of Science	e in Information Engineering Techno	ology		6	А
Exchange Progra	amme in Computer Science (master's	s level)		6	А
Exchange Progra	amme Information Engineering Tech	nology		6	Α

Teaching languages

English

Keywords

Internet of Things (IoT), embedded systems, wireless networks, embedded web services, positioning, IoT security, open standards.

Position of the course

At an amazing pace, new devices, mainly embedded devices, are being connected to the Internet. This revolution will transform the traditional human-centric internet to an Internet of Things (IoT), thereby enabling a whole new range of intelligent services in domains such as manufacturing, health, smart homes, logistics, etc. The aim of this course is to give insight in the wide variety of platforms, wireless communication technologies and network protocols that are available to realize this Internet of Things.

Contents

- 1 Introduction to IoT
- 2 IoT hardware platforms and operating systems:
- 3 Wireless communication technologies for IoT: physical layer and MAC layer aspects, wireless IoT standards including LPWAN technologies (LoRa, SigFox, IEEE 802.11ah, NB-IoT), IEEE 802.15.4(e), BLE and BLE meshing
- 4 IP-connected smart objects and networks: IPv6 protocol stack for constrained devices, the 6LoWPAN adaptation layer, routing in multi-hop sensor networks
- 5 Embedded web services and Web of Things: HTTP for constrained devices, the Constrained Application Protocol, discovery, device management (LWM2M), data models (LWM2M and IPSO)
- 6 Other relevant standardization bodies and protocols: Open Connectivity

Foundation, publish-subscribe (MQTT), Thread, initiatives of big industrial players, etc.

- 7 Tracking, tracing and positioning
- 8 IoT Security: threats and attacks, protection
- 9 Recent evolutions in IoT: open standards on top of LPWAN, management of constrained networks, Industrial IoT

Initial competences

Having followed with success the bachelor course Communication Networks (E008620), or having followed with success the courses Computernetwerken I: basisprotocollen (E761020) and Computernetwerken II: netwerkbeheer (E761031), or having acquired the envisaged competences through an alternative way.

Final competences

- 1 To describe the operation of current standards for IoT communication.
- 2 To understand and discuss the strengths and weaknesses of existing IoT communication solutions
- 3 To assess the impact of implementation decisions for an IoT system (e.g. choice of communication technology, interaction model, etc.)
- 4 To design communication protocols tailored to the constraints of embedded devices.
- 5 To evaluate the performance of an IoT communication solution.
- 6 To implement, assess and report on a recent IoT technology.
- 7 To be able to follow and understand future developments in the IoT domain.
- 8 To translate the requirements of a targeted IoT system into a concrete solution

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Group work, Seminar, Lecture, Practical, Independent work

Extra information on the teaching methods

- Lecture: chapters 1, 2, 3, 7, 8, 9
- Guided self-study: chapters 4, 5, 6 (knowledge clips)
- Seminar: coached exercises
- Practicum
 - MAC protocol design (online)
 - Low-power wide area networking: LoRaWAN simulation study (online)
 - Embedded web service technology: hands-on
 - Analysis of the IETF protocol stack for embedded devices using simulator (online)
 - Publish-suscribe paradigm using MQTT and Arduino: hands-on
 - Bluetooth Low Energy: hands-on
- Group work
 - Exploration of an IoT topic of choice (3 possible choices)

Study material

Type: Syllabus

Name: Internet of Things Indicative price: € 30 Optional: no Language : English Number of Pages : 520 Available on Ufora : Yes Online Available : Yes Available in the Library : No Available through Student Association : Yes

References

- Fundamentals of Wireless Sensor Networks Theory and Practice, Wiley, 2010.
- Interconnecting Smart Objects with IP The Next Internet, J.-P. Vasseur and A.

Dunkels, Morgan Kaufmann, 2010.

- Building the Web of Things, Dominique Guinard and Vlad Trifa, 2016.
- Wireless Positioning Technologies and Applications, Second Edition, Alan Bensky, Artech House, 2016.

Course content-related study coaching

- Interactive support through the electronic learning platform (forum, e-mail)
- Personal: through electronic appointment

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment

Examination methods in case of periodic assessment during the second examination period

Written assessment

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is not possible

Extra information on the examination methods

During examination period

- Part 1: Written closed-book exam
- Part 2: Written open-book exam
- Second chance: possible
- During semester:
- Graded practicum
- Graded project work
- Second chance: not possible

Calculation of the examination mark

- Evaluation throughout semester as well as during examination period
- Special conditions
 - Evaluation throughout semester: 40% of the points for the practicum, 10% of the points for the project
 - Evaluation during examination period: 50% of the points
 - Second chance for evaluation throughout the semester is not possible. Points for evaluation throughout semester are transferred in case of second chance.
 - When the student obtains less than 8/20 for the evaluation during the examination period, they can no longer obtain a pass mark for the course unit as a whole. If the total score does turn out to be a mark of ten or more out of twenty, this is reduced to the highest fail mark (i.e. 9/20)