Università degli Studi di Padova

Master's degree ICT Internet Multimedia Engineering

Department of Information Engineering (DEI)
Master degree on ICT for Internet and Multimedia Engineering (MIME)

Internet of Things and Smart Cities
01 – Course introduction

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Let me introduce myself…

Marco Giordani (marco.giordani@unipd.it)

- Associate Professor.
- Background on 5G/6G network and protocol design.

Office hours

- Whenever you want… upon request!

Useful rules

- Please use [IOTSC] as a prefix for all email subjects.
- I usually respond to all emails within max. 1 day (*timeout*).
- If no response after 1 day, permission to RETX your request.

Google Scholar

Some kick-off questions…

What do you regard as the most interesting use of the Internet of Things?

https://www.mckinsey.com/Videos/video?vid=4422100477001&plyrid=IzQolWCsY

Some kick-off questions…

What's the biggest risk associated with the Internet of Things?

https://www.mckinsey.com/Videos/video?vid=4422003143001&plyrid=IzQolWCsY

Some kick-off questions…

What one factor would most accelerate the benefits of the Internet of Things?

https://www.mckinsey.com/Videos/video?vid=4421947624001&plyrid=IzQolWCsY

Some kick-off questions…

What's one policy change that would accelerate the benefits of the Internet of Things?

https://www.mckinsey.com/Videos/video?vid=4422100476001&plyrid=IzQolWCsY

Course structure

Objectives

The course will provide the following knowledge and skills:

1. To know and understand the basic concepts of the **Internet of Things**.
2. To apply the paradigms of the Internet of Things in telecommunications.
3. To know and understand the basic concepts of **Smart Cities**.
4. To be able to apply the paradigms of Smart Cities to real problems of city management, with particular reference to the aspects of ICT.

Course structure

Contents

PART 1: Internet of Things

1. Definition of the Internet of Things and the relative applications.
2. Internet of Things **system architecture.**
3. Internet of Things for **short-range communication:** RFID, NFC, Wi-Fi, IEEE 802.14.4, ZigBee, 6LowPAN.
4. Internet of Things for **long-range communication:** SigFox, LoRa, NB-IoT.
5. Internet of Things **wired technologies**.
6. Internet of Things **protocols:** HTTP, WebSocket, MQTT, CoAP.
7. Internet of Things **cloud architecture and services**.
8. Key **scientific challenges** for the Internet of Things related to the physical layer, addressing and routing, and security.

Course structure

Contents

PART 2: Smart Cities

1. Definition of Smart Cities and the applications, scientific and market trends.
2. **Examples** of Smart City applications (**GUEST LECTURES** with experts).
   - IoT for Cities: Worldsensing
   - IoT for Healthcare: Scripps Research
   - IoT for Industrial Automation: DAB Pumps
   - IoT for Smart Agriculture: X-FARM

Course structure

Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
08:30					
10:30					
12:30		**IOTSC** Room Ae 14:30 – 16:15		**IOTSC** Room Be 14:30 – 16:15	
14:30					
16:30					

Course structure

Schedule

- **6 credits** (48 hours, 24 lectures)
  - "Frontal" lectures
  - (Hands-on) LAB experiences
  - Guest lectures
  - Students' activities

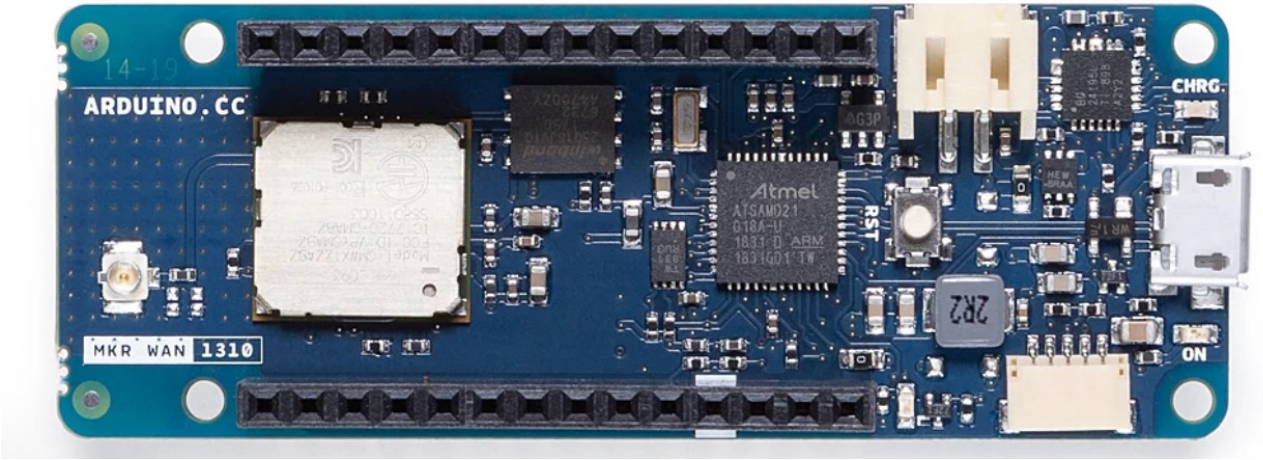
- Lectures will not be recorded: if you want, you can record audio with your devices.
- Lectures will not be live streamed.
- Attendance is not mandatory, but it is **recommended**.
- The exam will be on the book and the material that is also published in STEM.

Course structure

LAB

- Participation to the LAB sessions is **important and recommended** (we'll see…).
- We are planning 3(+1) "hands-on" **practical LAB experiences with LoRa**.
  - Configuring the Arduino board.
  - Establishing LoRa connections with a real working gateway.
  - Data processing and analysis.
- Group work and cooperation.
- Support from 2 young tutors/*angels*!
- Starting in November 2024.

Arduino MKR WAN 1310

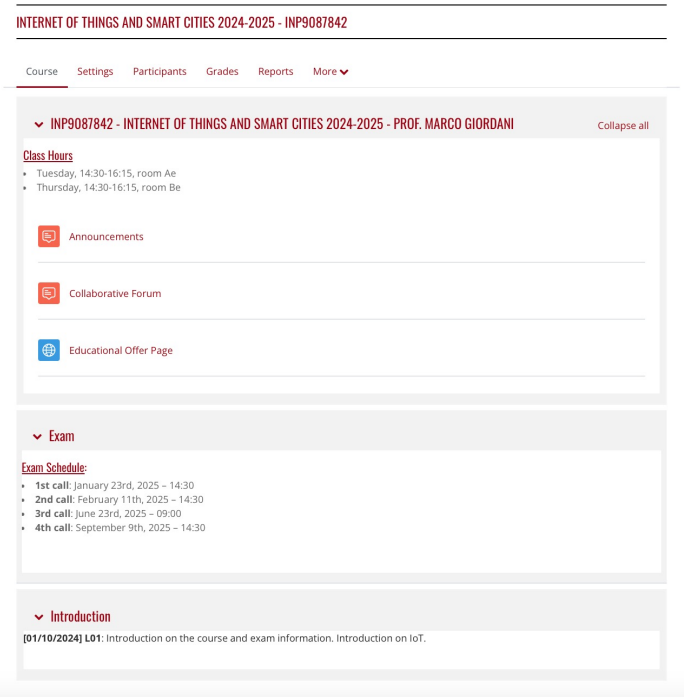


Course structure

STEM

- **Announcements**: Professor-to-student information exchange about change of class schedule, and other general aspects…
- **Collaborative Forum**: Cooperation with mates is one key skill that any successful engineer needs to know how to exploit.
- **Course** slides
- Information about **exams**
- Extra references
- Extra material
- …

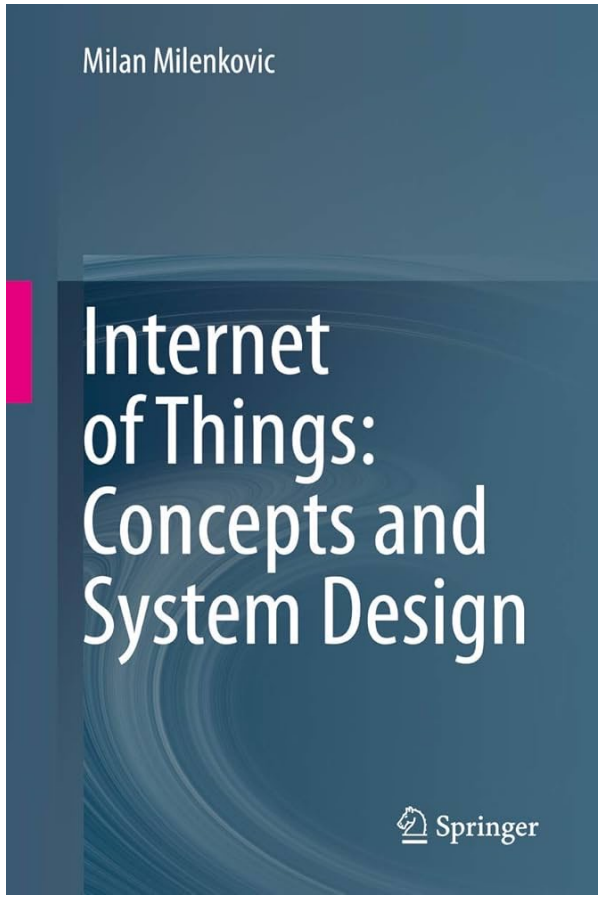
https://stem.elearning.unipd.it/course/view.php?id=9540



Bibliography

Reference textbooks

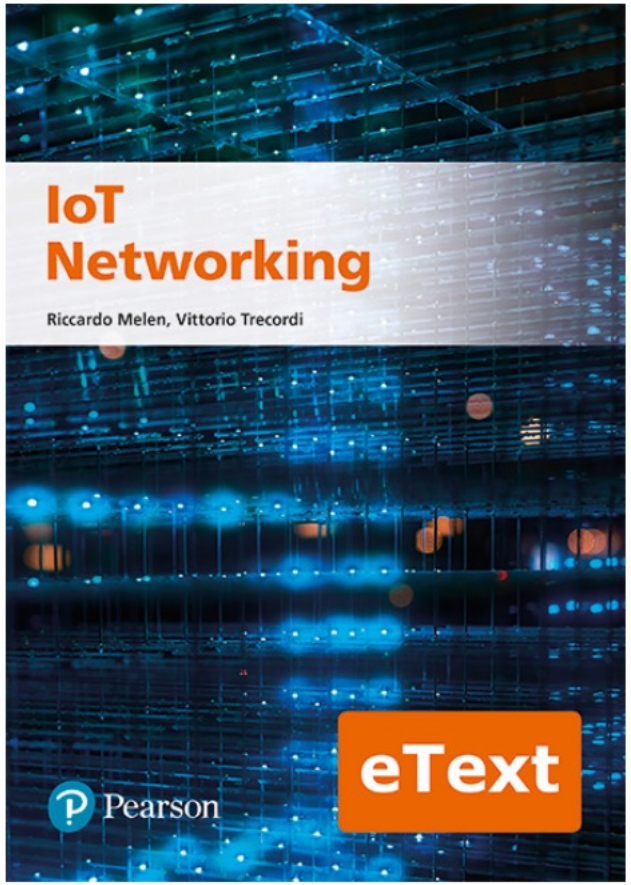
- **Internet of Things: Concepts and System Design**
  - Milan Milenkovic
  - ISBN: 978-3030413453
- It is available on the digital library of UNIPD:
  - https://biblioingegneriacentrale.cab.unipd.it/chi/sgc



Bibliography

Reference textbooks

- **IoT Networking**
  - Riccardo Melen, Vittorio Trecordi
  - ISBN: 9788883398032
- Digital copy is available for 19.9€ here: https://he.pearson.it/catalogo/2838

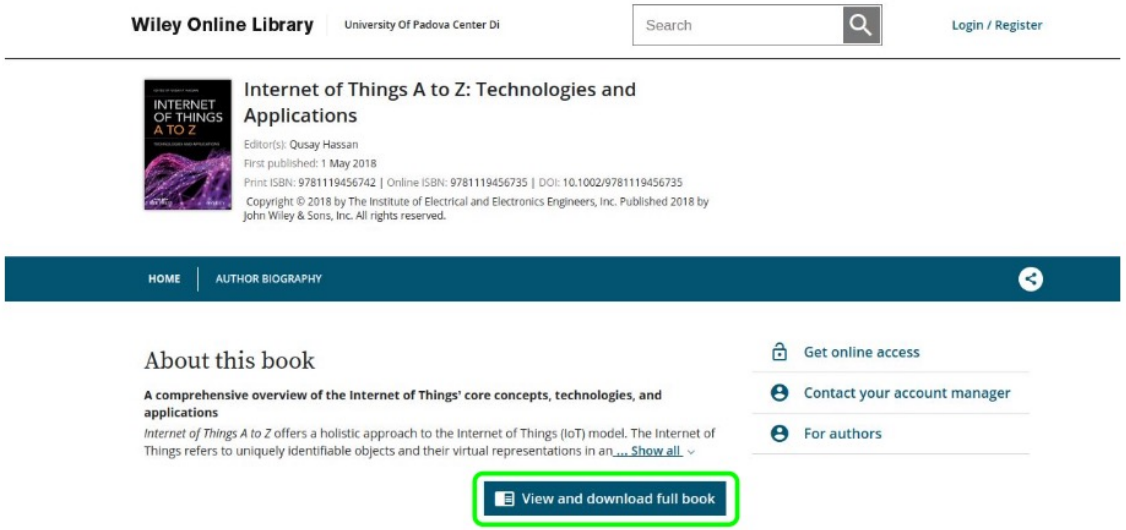


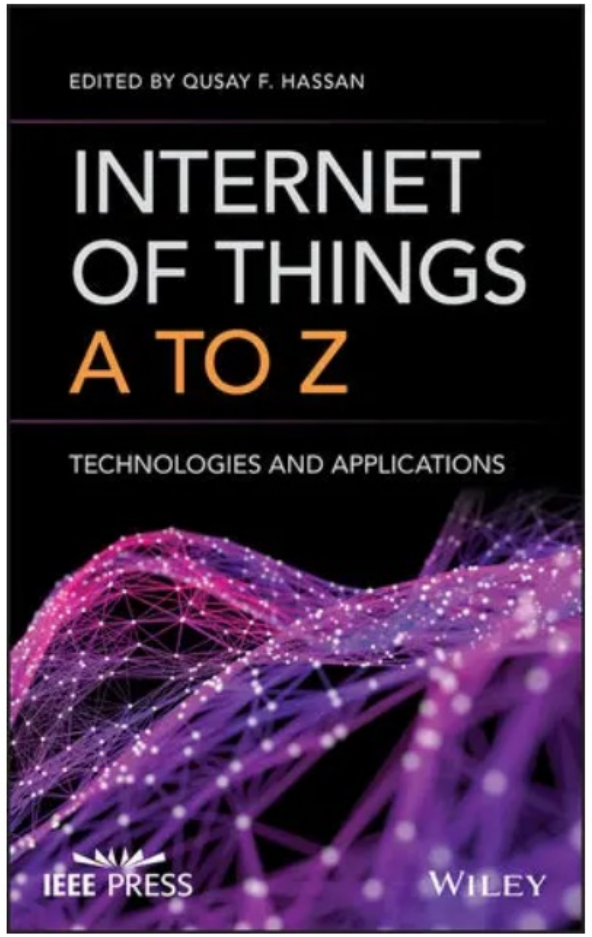
Bibliography

Reference textbooks

- **Internet of Things A to Z: Technologies and Applications**
  - Qusay F. Hassan (Editor)
  - ISBN: 978-1-119-45674-2

https://onlinelibrary.wiley.com/doi/book/10.1002/9781119456735





Bibliography

Other suggested books

- J. Vasseur, A. Dunkels, "Interconnecting Smart Objects with IP – The Next Internet," Morgan Kaufmann, 2010.
- Z. Shelby, C. Bormann, "6LoWPAN: The Wireless Embedded Internet," John Wiley & Sons, 2009.
- S. Mcclellan, J. A. Jimenez, G. Koutitas (Editors), "Smart Cities: Applications, Technologies, Standards, and Driving Factors," Springer, 2018.
- G. G. Parker, M. W. Van Alstyne, S. P. Choudary, "Platform Revolution: How Networked Markets Are Transforming the Economy and How to Make Them Work for You," W.W. Norton & Co, 2016.
- S. Greengard, "The Internet of Things," MIT Press, 2015.
- S. Farahani, "ZigBee Wireless Networks and Transceivers," Newnes, 2008.
- C. Anton-Haro, M. Dohler (Editors), "Machine-to-machine (M2M) Communications: Architecture, Performance and Applications," Woodhead Publishing, 2015.
- D. Kellmereit, D. Odovoski, "The Silent Intelligence – The Internet of Things," DnD Ventures, 2013.

Bibliography

But…

Should I buy the book(s)?

- Not necessarily…
- In class, I may refer to and collect material from many (different) books.
  - Attendance to lectures is important (and **highly recommended**).
- Slides we will uploaded to the STEM webpage of the course before each lecture.
  - **Slides (and attendance) are enough for passing the exam.**
- I might refer to book chapters or research papers that we will upload to STEM when needed.

Exam

Dates

- **1st call**: January 23rd, 2025 – 14:30
- **2nd call**: February 11th, 2025 – 14:30
- **3rd call**: June 23rd, 2025 – 09:00
- **4th call**: September 9th, 2025 – 14:30

Exam

Structure

- The exam consists of two parts:
  - **PART 1 (up to 28/33 points): Written test (mandatory)**
    - It consists of both Multiple Choice Questions (MCQ) and open questions.
    - It covers the whole couse syllabus.
    - Duration: 1.5 h.
  - **PART 2 (up to 5 extra points): LAB assessment (optional)**
    - It is an optional part of the exam: the exam can be passed with no PART 2, but the maximum grade (when combined with PART 1) would be 28/33.
    - It is a sort of "replication" of the LAB sessions of the course during the semester.
    - Participation to the LAB sessions during the semester is required.

Exam

Structure (examples)

PART 1 (Written) grade	PART 2 (LAB) grade	FINAL GRADE
27	3	30
27	5	32
21	5	26
21	3	24
15	5	20 (passed!)
22	2	24