# H8IOTFDEV: IoT Fundamentals and Development

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| **Module Code:** | H8IOTFDEV |
| **Long Title** | IoT Fundamentals and Development APPROVED |
| **Title** | IoT Fundamentals and Development |
| **Module Level:** | LEVEL 8 |
| **EQF Level:** | 6 |
| **EHEA Level:** | First Cycle |
| **Credits:** | 10 |
| **Module Coordinator:** | |
| **Module Author:** | Alex Courtney |
| **Departments:** | School of Computing |
| **Specifications of the qualifications and experience required of staff** | Either PhD or MSc in Computer Science or Cognate Discipline |

**Learning Outcomes**

*On successful completion of this module the learner will be able to:*

| # | Learning Outcome Description |
|---|---|
| LO1 | Analyse and appraise underlining technologies that support Internet of Things (IoT) and M2M communications |
| LO2 | Compare, contrast, and critique M2M communications, assessing the issues that exist and the proposed solutions |
| LO3 | Integrate the wireless technologies to create IoT applications |
| LO4 | Design and develop simulation/emulation scenarios for IoT applications using industry standard network simulator software. |

**Dependencies**

***Module Recommendations***

No recommendations listed

***Co-requisite Modules***

No Co-requisite modules listed

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| ***Entry requirements*** | Learners should have attained the knowledge, skills and competence gained from stage 3 of the BSc (Hons) in Computing. |

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## Module Content & Assessment

| Indicative Content |
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| **Internet of Things (IoT) Principles and Fundamentals**<br>From Internet to Internet of Things: opportunities, challenges, demand for new services• IoT enablers: energy, intelligence, communication, integration of smart devices, standards IoT architectures, networking and communications• RFID technology, smart sensors and sensor networks |
| **Mobile Communication Principles**<br>Basic networking principles such as layered architecture, connection-oriented vs. connectionless service• Summary of major issues differentiating wireless and wired networks: Mobility, handover, connectivity. |
| **Mobile Communication Principles - Continued**<br>Wireless Personal Area network: IEEE 802.15, IEEE 802.15.1 (Bluetooth), IEEE 802.15.2 (Co-Existence of PANs), IEEE 802.15.4 (Zigbee, Low Data Rate PAN). Applications of Zigbee: Building automation, needs to gateway. 6LowPAN. Industrial-Grade Network |
| **Machine-to Machine (M2M) Communication**<br>M2M market (e.g. Healthcare, transportation, energy, etc.) and its analysis. Usage models and potential customers. M2M high level architecture |
| **Machine-to Machine (M2M) Communication (continued)**<br>Examples of deployed M2M services (e.g. Smart Telemetry, Surveillance and security, Vending Machines, eHealth). M2M Security issues and solutions (e.g. public key, smart card). Wireless Sensors Networks and the Management thereof |
| **Wireless Technologies enabling IoT**<br>Examples through services such as RabbitMQ, Dweet etc.. IoT Standardization: challenges and issues e.g. Interoperability, Security and Privacy, Device and Systems Management, Device/Object Identity |
| **Wireless Technologies enabling IoT (continued)**<br>Standardisation efforts in CASAGARAS, W3C, ANEC, etc.. Examination of emerging technologies related to, or enabling, IoT |
| **Simulation and emulation of wireless networks and IoT application and services**<br>Introduction to network simulator and emulator tools (e.g. NS-3, Mininet-WiFi, Mininet-iot, Contiki). Practical work with simulator and emulator |
| **Simulation and emulation of wireless networks and IoT application and services (continued)**<br>Design, modelling and simulation of wireless networks enabling IoT using network simulator and emulation tools.• Design and implementation of simulation and emulation experiments deploying IoT and M2M applications/services |
| **IoT in Industry**<br>Architecture for the Connected Factory (Industrial Automation and Control Systems Reference Model)• Industrial Automation Control Protocols (e.g., Ethernet/IP and CIP, PROFINET, Media Redundancy Protocol (MRP), Modbus)• Edge Computing in the Connected Factory |
| **5G Enabled Internet of Things Motivation and Challenges**<br>Emerging Challenges and Requirements for IoT in 5G.• Cloud, Edge and Fog Computing for IoT in 5G.• SDN (Software Defined Networking) and NFV (Network Function Virtualization) based Internet of Things in 5G Networks. |
| **Revision Week**<br>Revision of all the above topics |

| Assessment Breakdown | % |
|---|---|
| Coursework | 40.00% |
| End of Module Assessment | 60.00% |

**Assessments**

### Full Time

**Coursework**

| | | | |
|---|---|---|---|
| **Assessment Type:** | Formative Assessment | **% of total:** | Non-Marked |
| **Assessment Date:** | n/a | **Outcome addressed:** | 1,2,3,4 |
| **Non-Marked:** | Yes | | |

**Assessment Description:**
Formative assessment will be provided on the in-class individual or group activities.

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|---|---|---|---|
| **Assessment Type:** | Assignment | **% of total:** | 40 |
| **Assessment Date:** | n/a | **Outcome addressed:** | 1,2,4 |
| **Non-Marked:** | No | | |

**Assessment Description:**
Involves the usage of a low-level network simulator, through which the learner interacts and modifies by way of programming. This enables the learner to gain a deep understanding of the network simulation and the networking protocols being simulated while honing their skills in programming. The learner will then analyse and appraise research papers in the domain and describe their results.in IoT and M2M communications.

**End of Module Assessment**

| | | | |
|---|---|---|---|
| **Assessment Type:** | Terminal Exam | **% of total:** | 60 |
| **Assessment Date:** | End-of-Semester | **Outcome addressed:** | 1,2,3 |
| **Non-Marked:** | No | | |

**Assessment Description:**
Written exam will assess learner's knowledge and gained problem solving skills. The learner will have to demonstrate and ability to analyse and provide a critique of the underlying IoT technologies. The assessment will involve a judicious analysis of limiting factors in IoT adoption

No Workplace Assessment

**Reassessment Requirement**

**Repeat examination**
*Reassessment of this module will consist of a repeat examination. It is possible that there will also be a requirement to be reassessed in a coursework element.*

**Reassessment Description**
Repeat examination Reassessment of this module will consist of a repeat examination. It is possible that there will also be a requirement to be reassessed in a coursework element. Learners who fail this module will be afforded an opportunity to take the repeat module assessment where all learning outcomes will be assessed.

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## Module Workload

**Module Target Workload Hours 0 Hours**

**Workload: Full Time**

| *Workload Type* | *Workload Description* | *Hours* | *Frequency* | *Average Weekly Learner Workload* |
|---|---|---|---|---|
| Lecture | Classroom & Demonstrations (hours) | 24 | Every Week | 24.00 |
| Tutorial | Other hours (Practical/Tutorial) | 24 | Every Week | 24.00 |
| Independent Learning | Independent learning (hours) | 202 | Every Week | 202.00 |
| | | | Total Weekly Contact Hours | 48.00 |

**Workload: Part Time**

| *Workload Type* | *Workload Description* | *Hours* | *Frequency* | *Average Weekly Learner Workload* |
|---|---|---|---|---|
| Lecture | No Description | 24 | Per Semester | 2.00 |
| Tutorial | No Description | 36 | Per Semester | 3.00 |
| Independent Learning | No Description | 190 | Per Semester | 15.83 |
| | | | Total Weekly Contact Hours | 5.00 |

## Module Resources

*Recommended Book Resources*


**David Hanes,Jerome Henry. Iot Fundamentals, [ISBN: 978-1587144561].**

**Yulei Wu. (2019), 5G-Enabled Internet of Things, CRC Press, p.396, [ISBN: 9780367190101].**

**Ashton, Kevin.. (2009), , That 'internet of things' thing, RFID Journal.**

**Mattern, Friedemann, and Christian Floerkemeier. (0), From the Internet of Computers to the Internet of Things, Active data management to event-based systems and more.**


*Supplementary Book Resources*


**Daniel Wong ,. (2012), ,Fundamentals of Wireless Communication Engineering Technologies ,Wiley-Blackwell.**

**David Boswarthick, Omar Elloumi, Oliver Hersent ,. (2012), ,M2M Communications: A Systems Approach ,1 ,Wiley ,.**

**Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stephan Avesand, Stamatis Karnouskos, David Boyle ,. (2014), , From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Academic Press,.**


**Article/Paper List.**

**Type.**

**Item.**

*This module does not have any article/paper resources*

*This module does not have any other resources*

| **Discussion Note:** | |
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