FACULTY OF APPLIED SCIENCES

MASTER OF SCIENCE IN BIG DATA AND INTERNET OF THINGS

LEARNING MODULE OUTLINE

Academic Year	2025/2026	Semester	1
Module Code	COMP6131		
Learning Module	IoT Essentials		
Pre-requisite(s)	Nil		
Medium of Instruction	English		
Credits	3	Contact Hours	45 hrs
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MODULE DESCRIPTION

This module provides a comprehensive overview of the Internet of Things (IoT) from the global context, and introduces the design fundamentals of the IoT. An IoT environment should facilitate interactions among intelligent machines, smart devices, ubiquitous computers, physical objects and human users. A number of underlying technologies enabling IoT will be discussed, for example, the sensing technologies, wireless sensor networks, machine-to-machine communications, Cloud and Fog computing technologies, etc. In particular, the core system architectures, such as the middleware to design single device and multi-device systems, will be discussed. In order to obtain more hands-on experience in building IoT applications, project-based system constructions through interconnecting different smart sensing devices and programming Raspberry Pi and Arduino single board computers will be covered.

MODULE INTENDED LEARNING OUTCOMES (ILOS)

On completion of this learning module, students will be able to:

M1.	Justify the need of IoT in a range of complex application domains; (AHEP4-M2)
M2.	Critically evaluate heterogeneous devices; (AHEP4-M3, AHEP4-M4)
M3.	Synthesize functional IoT systems through various programmable sensors/devices; (AHEP4-M5)
M4.	Justify the roles of various technologies in enabling IoT; (AHEP4-M3, AHEP4-M4)
M5.	Analyze and determine the domain requirements for building different complex IoT solutions; (AHEP4-M2, AHEP4-M5)
M6.	Design advanced the IoT-based applications based on user needs. (AHEP4-M5, AHEP4-M16, AHEP4-M17)

These ILOs aims to enable students to attain the following Programme Intended Learning Outcomes (PILOs):

PILOs		M1	M2	M3	M4	M5	M6
P1.	Master the principles of system engineering and relevant enabling technologies for building of IoT solutions	✓	✓		✓		
P2.	Critically evaluate scientific methodologies and mathematical models for Big Data and its applications		✓			✓	
P3.	Master the advanced software and programming tools and techniques for IoT solutions and Big Data						✓
P4.	Explain the processes involved in IoT solutions and Big Data analytics in a typical business setting						
P5.	Explain different application domains and analyze their requirements for IoT and Big Data	✓		✓		✓	
P6.	Apply knowledge in advanced communication and multimedia technologies for the design and implementation of IoT solutions						✓
P7.	Apply knowledge in applied statistics, machine learning, leading-edge technologies and programming techniques for Big Data						
P8.	Design and carry out an advanced project following an ethical and professional methodology						
P9.	To demonstrate advanced knowledge and R&D techniques in Big Data and IoT						✓
P10.	To investigate and develop new, emerging ICT technology for Big Data and IoT						
P11.	To develop a global vision on the critical development and new application of Big Data and IoT						
P12.	To communicate technically and effectively in both speaking and writing						
P13.	To have a positive attitude towards society and the environment.						
P14.	To adhere to high moral standards and commit to excellence in life-long learning.						

MODULE SCHEDULE, COVERAGE AND STUDY LOAD

Week	Content Coverage	Contact Hours
1	1. Introduction (3 hours)	3
	1.1 Understand the design fundamentals of IoT and some feature applications	
	1.2 Incorporate design ideas of wireless sensor networks (WSNs) and machine-to-machine (M2M) communications	
	1.3 Outline the functionalities of sensing devices and sink/gateway components	
2	2. Models and architectures of IoT	3
	2.1 Discuss different architectural models of IoT and their basic operating components	
	2.2 Identify the functional models of the Internet and Cloud Computing in IoT	
	2.3 Outline the relationship between edge / fog computing and WSNs	

3	3. Sensing devices	6
	3.1 Elaborate the physics underneath different sensing devices	
	3.2 Apply sensing devices to different operating scenarios for different applications	
4	4. Hardware platforms for IoT	3
	4.1 Discuss available single board computing platforms for IoT systems	
	4.2 Review common coding languages for different single board computers (SBCs)	
	4.3 Understand basic coding platforms for, e.g., Arduino and Raspberry Pi devices	
5	5. Layer protocols for IoT	12
	5.1 Review in detail some common link layer (BLE, BT mesh, ZigBee), and transport layer (UDP, TCP) technologies for sensing devices	
	5.2 Explore 6Lo protocols for interfacing higher layer protocols	
	5.3 Review IPv6 (cross reference to IPv4) and interoperability to link layer wireless protocols	
	5.4 Define routing protocols among sensors and gateways, e.g., the IPv6 Routing Protocol for Low Power and Lossy Networks (RPL)	
6	6. Application layer protocols	12
	6.1 Understand the needs of sensor management	
	6.2 Introduce and discuss features and functionalities of different application layer protocols, such as, Constrained Access Protocol (CoAP), Message Queue Telemetry Transport (MQTT, MQTT-SN), and Advanced Message Queueing Protocol (AMQP), etc.	
7	7. Security and privacy issues (3 hours)	3
	7.1 Investigate with case studies	
8	8. Other design issues (3 hours)	3
	8.1 Topic: Describe interoperability and reliability issues	
	8.2 Topic: Analyse performance with a selected IoT platform	

TEACHING AND LEARNING ACTIVITIES

In this learning module, students will work towards attaining the ILOs through the following teaching and learning activities:

Teaching and Learning Activities	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**
T1. Lectures	✓	✓	✓		✓	
T2. case studies		✓	✓	✓	✓	✓
T3. group presentation				✓	✓	✓

T4. discussion				✓	✓	✓

ATTENDANCE

Attendance requirements are governed by the Academic Regulations Governing Master's Degree Programmes of the Macao Polytechnic University. Students who do not meet the attendance requirements for the learning module shall be awarded an 'F' grade.

ASSESSMENT

In this learning module, students are required to complete the following assessment activities:

Assessment Activities	Weighting (%)	AHEP4 LOs	ILOs to be Assessed
A1. Assignments	35%	AHEP4-M4	M1, M5
A2. Test	25%	AHEP4-M2, AHEP4-M3	M1, M2, M4, M5
A3. Group project	40%	AHEP4-M2, AHEP4-M4, AHEP4-M5, AHEP4-M16, AHEP4-M17	M1, M2, M3, M4, M5, M6

The assessment will be conducted following the University's Assessment Strategy (see www.mpu.edu.mo/teaching_learning/en/assessment_strategy.php). Passing this learning module indicates that students will have attained the ILOs of this learning module and thus acquired its credits.

Students with an overall score of less than 35 in the coursework will fail the module even if the overall score for the module is 50 or above.

Students with a score of less than 35 in the final examination will fail the module even if the overall score for the module is 50 or above.

REQUIRED READINGS

1. There is no official text for this module. Module notes are distributed in classes.

REFERENCES

1. Lea P. (2020) *Internet of Things for Architects, Second Edition*, Packt Publishing.
2. Cirani S., Ferrari G., Picone M., Veltri L. (2019) Internet of Things – Architectures, Protocols and Standards, John Wiley & Sons Ltd.
3. Oualline S. (2022) *Bare Metal C*, No Starch Press, San Francisco.
4. R. Quan, *Troubleshooting Electronic Circuits – Debugging and Improving Your DIY Projects and Experiments*, McGraw-Hill Education, 2020.

STUDENT FEEDBACK

At the end of every semester, students are invited to provide feedback on the learning module and the teaching arrangement through questionnaires. Your feedback is valuable for instructors to enhance the module and its delivery for future students. The instructor and programme coordinators will consider all feedback and respond with actions formally in the annual programme review.

ACADEMIC INTEGRITY

The Macao Polytechnic University requires students to have full commitment to academic integrity when engaging in research and academic activities. Violations of academic integrity, which include but are not limited to plagiarism, collusion, fabrication or falsification, repeated use of assignments and cheating in examinations, are considered as serious academic offenses and may lead to disciplinary actions. Students should read the relevant regulations and guidelines in the Student Handbook which is distributed upon the admission into the University, a copy of which can also be found at www.mpu.edu.mo/student_handbook/.