City University of Hong Kong
Course Syllabus

offered by Department of Electrical Engineering
with effect from Semester B 2022/2023

Part I Course Overview

Course Title:	Internet of Things Technologies for Future City Applications
Course Code:	EE5437
Course Duration:	One Semester (13 weeks)
Credit Units:	3
Level:	P5
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	EE2004-Microcomputer Systems / EE3220 – System-on-Chip Design or courses related to firmware coding on MCU
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

Hong Kong aims to be built into a world class smart city through adopting the measures set out in the Smart City Blueprint 2.0 for Hong Kong. There are six major areas including 1) Smart Mobility, 2) Smart Living, 3) Smart Environment, 4) Smart People, 5) Smart Government, and 6) Smart Economy. This course aims to provide students with a fundamental understanding of Internet of Things (IoT) technologies including sensors, electronics, communication (e.g. 5G), networking, data processing, cloud computing, Artificial Intelligence, etc.. IoT is the key technology for Smart City future applications / Future City applications.

This course will introduce the concept, framework, and IoT technologies of smart cities in the above areas, as well as course project integrating with several assignments to offer practical skills training. Throughout the course, students will learn the IoT technologies in designing and implementing solutions for future smart and sustainable cities. Students are encouraged to learn practical skills to adopt technological solutions to their proposed smart city applications to further develop their innovation. Students will learn these topics through lectures, assignments, self-study, project, and presentation.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	The student will learn about the Introduction to Smart City Blueprint and the six major areas including 1) Smart Mobility, 2) Smart Living, 3) Smart Environment, 4) Smart People, 5) Smart Government and 6) Smart Economy		✓		
2.	The student will learn about the Internet of Things Technologies for the above Smart City Future Applications including 1) System Design 2) Sensors and actuators, 2) Control interface, 3) Communication interface, 4) System Model, 5) Mobile Computing, and 6) Data Processing including Cloud Computing and Artificial Intelligence.		✓		
3.	Students will form groups to collaborate on projects about future applications for Smart City by using the IoT technologies. The project includes several assignments with step-by-step guidelines to help students to learn and develop the solution for the Smart City application with team work experience.			✓	
4.	Students will learn about how to propose a project topic, plan for the development, execute the plan and present the work done through this project based course that will help students to strengthen their organization and presentation skills by showing their work with demonstrations as well as question and answer experiences. Final exam will help students to apply the knowledge they learned in this course to a challenge of examination with quantified results.				✓
		100%			

A1: *Attitude*
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: *Ability*
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4			
Interactive Lectures (merging lectures for theories and practical lectures for development skills)	Introduce IoT Technologies theory and industrial examples, as well as the applications and future trends in smart cities with the practical examples.	✓	✓	✓				2 hours / week for total 13 weeks
Guest Lectures	Invite experts from government, ASTRI, or Smart City Consortium to share about Smart City development and application in HK.	✓	✓					1 hour in lecture (Total 3 guest lectures)
Project-based Learning	Practical tutorial will introduce sensors, micro controller unit (MCU), communication platform to help students to make prototypes and demonstrations for Smart City applications.	√	√	√	√			1 hour Practical Lecture / week for total 9 weeks

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3	4				
Continuous Assessment: 70%								
Tests (min: 2)	✓	✓					40%	
#Assignments (min: 3)	✓	✓					10%	
Lab Exercises/Reports and Presentation	✓	✓	✓	✓			20%	
Examination: 30% (duration: 2hrs , if applicable)								
Examination	✓	✓	✓	✓			30%	
							100%	

Remark:
To pass the course, students are required to achieve at least 30% in course work and 30% in the examination. Also, 75% laboratory attendance rate must be obtained.
may include homework, tutorial exercise, project/mini-project, presentation

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B,)	Marginal (B-, C+, C)	Failure (F)
1. Examination	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level

Applicable to students admitted before Semester A 2022/23

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Examination	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level

6. Constructive Alignment with Programme Outcomes

PILO	How the course contribute to the specific PILO(s)
1	The student will acquire an ability to describe current and anticipated trends in IoT Technologies through lectures, tutorials, assignments, course project and presentation.
2	The student will be able to evaluate and analyze new technologies in IoT Technologies through lectures, tutorials, assignments, course project and presentation.
3	The student will be able to apply specialist knowledge in the topics in IoT Technologies through the lectures, tutorials, assignments, course project and presentation.

Part III Other Information (more details can be provided separately in the teaching plan)

1. **Keyword Syllabus**

The course will give an overview of Internet of Things Technologies for Future City applications. We will cover:

Week 1 [Introduction to Smart City]: Introduction to Smart City Blueprint, and the six major areas including 1) Smart Mobility, 2) Smart Living, 3) Smart Environment, 4) Smart People, 5) Smart Government, and 6) Smart Economy.

Week 2 [Introduction to Smart City Applications]: Introduction to Smart City Applications and the related technologies.

Week 3 [Introduction to System Design]: Introduction to system, hardware and software, block diagram, interface, input and output. Based on real examples to share about system and control. To learn block diagram and interface.

Week 4 [Internet of Things (IoT) System]: Introduction to sensor, process unit and actuator as well as human-machine interface. To learn the structure and design of sensor and actuator system.

Week 5 [Introduction to Sensors]: Sensors and interface. To learn the principles of sensors, interface protocol, and types of sensors.

Week 6 [Data Processing]: Introduction to data processing including different filters and mathematics.

Week 7 [Control Interface System]: System model, design, and control. To learn the modelling and design of a system.

Week 8 [Communication Interface]: Wired and wireless system and interface. To learn the communication interfaces of wired and wireless systems such as IIC, SPI, serial communication, Bluetooth, ZigBee, WiFi, etc..

Week 9 [Actuator and Feedback]: Feedback (visual, sound, smell, force). To learn the principles of actuators, types of actuators, and different feedback and action by using different actuators and motors.

Week 10 [System Model]: Simulation, mathematical model, dynamic equations, control. To learn the mathematics behind the simulations.

Week 11: [Controller]: Control theory. Apply system controllers to IoT systems.

Week 12 [Mobile Computing and Artificial Intelligence]: Introduction to mobile computing for data analytics and user interface and Artificial Intelligence (AI) and deep learning. To learn basic AI and learning in different applications for IoT.

Week 13 [Project Presentation].

Lab Arrangement:

- Lab01: Introduction to ThingsBoard and TTN. Registration to https://thingsboard.io/ and demo code
- Lab02: Introduction to ESP32 simulator. Registration to https://wokwi.com/
- Lab03: Data collection, system model and communication (ThingsBoard API interface: MQTT API, HTTP API, and etc) (https://thingsboard.io/docs/api/)
- Lab04: Data visualization and control (Dashboard Creation and introduction to data visualization in ThingsBoard such as Cards, Charts, Analogue Gauges and Digital gauges) as well as Control widget (https://thingsboard.io/docs/user-guide/contribution/widgets-development/)
- Lab05: System integration and implementation (Example: Temperature upload over MQTT using ESP8266 and DHT22 sensor: ThingsBoard: Temperature upload over MQTT using ESP8266 and DHT22 sensor)

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Internet of Things for Architects by Perry Lea. Publisher: Packt Publishing
2.	IoT Inc: How Your Company Can Use the Internet of Things to Win in the Outcome Economy by Bruce Sinclair. Publisher: McGraw-Hill Education
3.	The Amazon Way on IoT: 10 Principles for Every Leader from the World's Leading Internet of Things Strategies by John Rossman. Publisher: Clyde Hill Publishing
4.	Handbook of Modern Sensors: Physics, Designs, and Applications by Jacob Fraden. Publisher: Springer
5.	Sensors and Actuators: Engineering System Instrumentation by de Silva, Clarence W. Publisher: CRC Press

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	The Smart City Blueprint for Hong Kong: https://www.smartcity.gov.hk/
2.	Smart City Consortium (SCC): https://smartcity.org.hk/
3.	Smart City by ASTRI – Hong Kong Applied Science and Technology Research Institute: https://www.astri.org/technology/smart-city/
4.	Smart City Platform with big Data by HKSTP (Hong Kong Science and Technology Park): https://www.hkstp.org/en/our-stories/technology-and-innovation/smart-city-platform/