EE5437: INTERNET OF THINGS TECHNOLOGIES FOR FUTURE CITY APPLICATIONS

Effective Term
Semester B 2025/26

Part I Course Overview

Course Title
Internet of Things Technologies for Future City Applications

Subject Code
EE - Electrical Engineering
Course Number
5437

Academic Unit
Electrical Engineering (EE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
EE2004-Microcomputer Systems / EE3220 - System-on-Chip Design or courses related to firmware coding on MCU

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

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.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-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		x		
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.		x		
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.			x	
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.				x

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 real-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.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	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.	1, 2, 3	2 hours / week for total 13 weeks
2	Guest Lectures	Invite experts from government, ASTRI, or Smart City Consortium to share about Smart City development and application in HK.	1, 2	1 hour in lecture (Total 3 guest lectures)
3	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, 2, 3, 4	1 hour Practical Lecture / week for total 9 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Tests (min: 1)	1, 2	25	-	No
2	#Assignments (min: 3)	1, 2	10	Allow use GenAI for searching information	Yes
3	Lab Exercises/ Reports and Presentation	1, 2, 3, 4	15	Allow use GenAI for searching information	Yes

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

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

Assessment Rubrics (AR)

Assessment Task

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Achievements in CILOs

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal level

Assessment Task

Coursework (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Achievements in CILOs

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal level

Assessment Task
Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Medium

Marginal
(B-, C+, C) Low

Failure
(F) Not even reaching marginal level

Assessment Task
Coursework (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Medium

Marginal
(B-, C+, C) Low

Failure
(F) Not even reaching marginal level

Additional Information for AR

Constructive Alignment with Programme Outcomes

PILO 1 - The student will acquire an ability to describe current and anticipated trends in IoT Technologies through lectures, tutorials, assignments, course project and presentation.
PILO 2 - The student will be able to evaluate and analyze new technologies in IoT Technologies through lectures, tutorials, assignments, course project and presentation.
PILO 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

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)

Reading List

Compulsory Readings

	Title
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

Additional Readings

	Title
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/
5	Smart City 3.0 by SCC: https://smartcity.org.hk/en/info-smartcity.php