Subject Description Form

Subject Code	EIE2113
Subject Title	Introduction to Internet of Things
Credit Value	3
Level	2
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: The students are expected to have some basic knowledge on computer hardware and software, as well as computer networks.
Objectives	1. To provide an overview on the Internet of things (IoT) including circuits, sensors, embedded systems, communications and networking, data processing, and security; 2. To introduce basic hands-on IoT concepts including sensing, actuation, and communications through lab exercises with IoT development kits.
Intended Learning Outcomes	**Upon completion of the subject, students will be able to:** Category A: Professional/academic knowledge and skills 1. Understand key IoT concepts on circuits, sensors, embedded systems, communications and networking, and data processing; 2. Basic hands-on skills on developing simple IoT applications. Category B: Attributes for all-roundedness 3. Understand the creative process when designing solutions to a problem; 4. Take up new technology for life-long learning.
Subject Synopsis/ Indicative Syllabus	1. Introduction to the Internet of Things (IoT) - What is IoT? Why is IoT important? - The IoT system stack: Sensors, edge computing, networking, cloud computing - How IoT could enable innovative products and services - Introduction of IoT Security 2. Cool IoT Applications - Smart cities: waste management, street lights, and connected vehicles - Healthcare: Baby monitoring, elderly monitoring, mood enhancing, disease treatment, enhance adherence and challenges 3. Electronics for IoT - Overview of electronic signals and circuits (sampling and the Nyquist theorem) - Battery current - Energy management and wireless links - Digital computing - ADC and DAC concepts 4. Sensors for IoT - Sensor terminology - Sensor dynamics and specifications - Linearization and error - Sampling frequency and bandwidth requirements for different sensors - Interface common sensors and actuators to IoT development kits 5. Embedded Systems for IoT - Typical cost and computing an energy budget - Energy management and sleep states - Microcontrollers: Peripherals, buses, and direct memory access (DMA) - General purpose input/output (GPIO) and pulse width modulation (PWM) - Operating systems and multiprogramming

6. Software and Data Analytics for IoT
   - Libraries of development kits and examples (e.g., Arduino)
   - Selection of development programming languages for different IoT services
   - Web server and web services (e.g., ThingsBoard, MQTT/HTTP)
   - Data analytics with machine learning techniques (e.g., Python, Anaconda)

7. Connectivity and Networking for IoT
   - Historical evolution of wireless systems
   - Energy harvesting and wirelessly powered transmitters
   - Capacity of wireless channels
   - Massive multiple access and embracing collisions
   - Computation versus communication
   - Low power wide area networks (LPWAN)

Teaching/Learning Methodology

The theories and applications of IoT will be described and explained in lectures. Tutorial and lab sessions will be conducted to deliver hands-on skills on prototyping IoT products and applications based on IoT development kits. The assignments and lab exercises will help students review the knowledge taught in class.

Teaching/Learning Methodology	**Intended Subject Learning Outcomes**			
	1	**2**	**3**	**4**
Lecture and Tutorial	✓	✓		
Laboratory and Practical Sessions	✓	✓	✓	✓
Assignments and lab exercises	✓	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific Assessment Methods/Tasks	**% Weighting**	**Intended Subject Learning Outcomes to be Assessed (Please tick as appropriate)**			
		1	**2**	**3**	**4**
1. Continuous Assessment					
• Homework and assignments	10%	✓	✓	✓	✓
• Tests	10%	✓	✓		
• Laboratory exercises	30%	✓	✓	✓	✓
2. Examination	50%	✓	✓		
Total	100%				

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Assignments, tests/quizzes, and examination let students review the taught materials, do further reading for deeper learning and apply the learnt materials to solving problems.

Lab exercises require students to do further reading, search for information, keep abreast of current IoT development, and develop their own IoT prototypes.

Student Study Effort Expected	**Class contact (time-tabled):**	
	• Lectures	27 Hours
	• Tutorial/Laboratory/Practice Classes	12 Hours
	Other student study effort:	
	• Lecture: preview/review of notes; homework/assignment; preparation for test/quizzes	36 Hours
	• Tutorial/Laboratory/Practice Classes: preview of materials, revision and/or reports writing	30 Hours
	Total student study effort:	**105 Hours**
Reading List and References	**Textbook:** 1. R. Buyya, A. V. Dastjerdi, *Internet of Things: Principles and Paradigms*, Cambridge, MA: Morgan Kaufmann, 2016. **Reference Materials:** 1. S. Greengard, *The Internet of Things*, Cambridge, MA: MIT Press, 2015. 2. A. Chaudhuri, *Internet of Things, for Things, and by Things*, Boca Raton, FL: CRC Press, 2019.	
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