AMERICAN UNIVERSITY
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Course Syllabus
ICT 360-Introduction to Internet of Things
3 Credits (3 Classroom Credit)

School Name:	*Digital Technologies*
Program Name:	*Degree & Major*
Semester:	*Fall 2025*
Class Schedule:	Mon/Thurs: (001) 08:30-10:00; (002) 12:00-01:30; (003) 01:45-03:15
Classroom:	Emerging Tech Lab-Robotic and IoT
Prof.'s Name:	Mr. SENG Theara
Degree & Major:	Master in Electronics and Robotics
Contact Info:	Email: t.seng@aupp.edu.kh
Office Location:	B15-Faculty Reception, Emerging Tech Lab-Robotic and IoT
Office Hours:	8:00AM-5:00PM

Note: *The syllabus is intended to provide guidance as to students' and the professor's obligations for this course. However, the professor reserves the right to modify syllabus items as needs arise, and students will be notified of any modifications.*

Course Description

This course introduces students to the fundamentals of **Internet of Things (IoT)** through hands-on projects using the Raspberry pi platform. Over 16 weeks, learners will explore how to connect devices, integrate sensors and actuators, and build applications that bridge the physical and digital worlds. Each week features a new device or module, giving students broad exposure to real-world IoT components and applications.

Students will gain practical experience in device programming, data collection, remote control, and visualization. Along the way, they will design interactive systems, connect devices to cloud services, and learn how multiple IoT nodes can communicate with each other. By the end of the course, participants will be able to design, implement, and present a working IoT prototype that demonstrates core concepts of connectivity, automation, and data-driven applications.

Table 1: Program Learning Outcomes (PLOs)

PLO Ref. #	**PLO Statement** By the end of the program, students will be able to:
1	Demonstrate advanced knowledge in ICT concepts.
2	Acquire expertise in ICT fields, enabling them to address complex ICT challenges effectively.

3	Develop critical thinking and problem-solving skills, applying them to analyze and resolve complex ICT-related issues and challenges
4	Cultivate effective communication and teamwork abilities, facilitating collaboration and knowledge sharing in multidisciplinary ICT environments.
5	Exemplify ethical responsibility and effective interpersonal skills, enabling them to collaborate professionally and make ethically informed decisions.
6	Excel in quantitative analysis, leverage cutting-edge information technology, and communicate effectively, enhancing their ICT problem-solving and communication abilities.
7	Demonstrate proficiency in executing technical tasks, practical applications, or laboratory experiments relevant to their chosen field of study.

Table 2: Course Learning Outcomes (CLOs)
[All sections of the same course must share the same CLOs.]

CLO Ref. #	**CLO Statement** By the end of the course, students will be able to:	**CLO Class**	**PLO Ref. #**
1	Understand the architecture, components, and real-world applications of IoT systems.	Knowledge, Skill	1,2,3,4
2	Set up and program a Raspberry Pi as an edge device for IoT projects.	Knowledge, Skill	1,2,3,4
3	Read and process data from multiple sensors using Python.	Knowledge, Skill	1,4,5
4	Send and receive data via MQTT and HTTP using public and private cloud services.	Knowledge, Skill	1,2,3,4
5	Visualize real-time sensor data on custom dashboards using Firebase, Node-RED, and Grafana.	Knowledge, Skill	1,2,3,4
6	Control devices remotely via mobile apps and web interfaces.	Knowledge, Skill	3,4,5,6
7	Implement voice-controlled actions using Amazon Alexa.	Knowledge, Skill	3,4,5,6
8	Design and build a complete IoT project integrating multiple platforms and communication methods.	Knowledge, Skill	3,4,5,6

Statement of relevance to Cambodia: *During the course there will be opportunities to relate the subject matter and assessments to the Cambodian context.*

Table 3: Course Assessments

[Use multiple types of assessment and provide rubrics for writing work.]

Assessment Task	**% of Course Grade**	**CLO Ref. #**	**Due Session #**
Mini Project	20%	1,2,3,4,5,6,7,8	Check Canvas
Quizzes	15%	1,2,3,4,5,6,7,8	Check Canvas

Assignment	15%	1,2,3,4,5,6,7,8	Check Canvas
Midterm Exam	10%	1,2,3,4	Check Canvas
Final Project	20%	1,2,3,4,5,6,7,8	Check Canvas
Lab	20%	1,2,3,4,5,6,7,8	Check Canvas
TOTAL	100%		

Grading Scale: *You will receive a letter grade based on the AUPP grading scale.*

Table 4: Course Outline

Session *[1.5 hr]*	**CLO Ref. #**	**Topic**	**Lesson Learning Outcome (LLO)** The lesson enables students to:	**T&L Method**	**Material**
1	1,2	Toolchain Setup & First Flash	- Install ESP32 IDE and drivers - Upload and run a blink program - Use Serial Monitor for debugging - Troubleshoot flashing issues	Demo + Guided Setup	Laptops, ESP32, USB cables, IDE
2	1,3	Telegram Relay Control	- Wire relay safely with ESP32 - Create and configure a Telegram bot - Implement ON/OFF commands - Verify relay state feedback	Demo + Lab	ESP32, relay module, Telegram
3	1,2,3	DHT11 Rule with Telegram	- Interface DHT11 sensor - Read and validate temperature data - Apply rule-based control logic - Send alerts via Telegram	Code-along + Lab	ESP32, DHT11, relay
4	1,2	Ultrasonic Sensor with I2C LCD	- Explain ultrasonic distance measurement - Measure distance using HC-SR04 - Configure I2C communication - Display formatted data on LCD	Mini-lecture + Lab	ESP32, HC-SR04, LCD1602 (I2C)
5	1,2,3,5	Local HTTP Control & Web UI	- Configure ESP32 Wi-Fi station mode - Build a local web server - Display sensor data on web UI - Control hardware via browser	Guided Lab	ESP32, sensors, browser
6	1,2,3	IR Sensor & Blynk Introduction	- Decode IR or obstacle sensor signals - Configure Blynk dashboard - Map hardware events to virtual pins - Analyze control latency	App Demo + Lab	ESP32, IR sensor, Blynk
7	1,2,3,5	Servo Control via Blynk + Quiz	- Control servo using PWM - Map slider values to angles - Apply motion limits and smoothing - Assess understanding via quiz	Lab + Quiz	ESP32, SG90 servo, Blynk
8	1,4	Mini Project 1 – Hardware Design	- Define system requirements - Draw architecture diagrams - Wire sensors and actuators safely - Perform power and safety checks	Studio Build	Team kits, checklist
9	2,3,4	Mini Project 1 – Software	- Implement firmware logic - Integrate UI or alerts - Apply version control practices - Test system functionality	Sprint Lab	ESP32, Git repository
10	3,4,5	Mini Project 1 – Demonstration	- Demonstrate system features - Explain design decisions	Presentations	Hardware, slides/video

			- Reflect on reliability and UX - Receive peer feedback		
11	2,3,5	BME280 with Node-RED	- Interface BME280 sensor - Stream data to Node-RED - Build real-time dashboard - Configure threshold alerts	Flow Demo + Lab	ESP32, BME280, Node-RED
12	3,5	InfluxDB & Grafana	- Store sensor data in InfluxDB - Query time-series data - Create real-time dashboards - Analyze 24-hour trends	Walkthrough + Lab	InfluxDB, Grafana
13	3,5	MQTT + Grafana Dashboard	- Publish data using MQTT - Subscribe via Node-RED - Store MQTT data in InfluxDB - Design scalable dashboards	Walkthrough + Lab	ESP32, MQTT, Node-RED, Grafana
14	1,2,3,5	Color Sensor Analytics	- Interface color sensor - Classify detected colors - Log color counts - Visualize data with charts	Demo + Lab	ESP32, TCS34725
15	1,2	Motor Control (H-Bridge & PWM)	- Explain H-bridge principles - Control motor speed and direction - Implement PWM signals - Discuss flyback and current limits	Mini-lecture + Lab	ESP32, L298N/DRV8833, motor
16	2,3,4	MIT App Inventor + Firebase	- Build Android app UI - Connect app to Firebase - Control ESP32 remotely - Measure system latency	Guided Lab	Android/Emulator, MIT App, ESP32
17	2,3,4	Mobile App Polishing & Auth	- Add status feedback - Implement debounce logic - Apply simple authentication - Improve usability	Studio Lab	Same as Session 16
18	1,4	Mini Project 2 – Hardware	- Select suitable components - Design power domains - Update wiring diagrams - Verify electrical safety	Studio Build	Team kits
19	2,3,4,5	Mini Project 2 – Software I	- Implement device communication - Build dashboards - Add alarms and logging - Test system stability	Sprint Lab	Laptops, servers
20	2,3,4,5	Mini Project 2 – Software II	- Refine firmware logic - Optimize cloud integration - Improve error handling - Prepare for demo	Sprint Lab	Laptops, servers
21	3,4,5	Mini Project 2 – Demo	- Present completed system - Conduct peer review - Document improvements - Reflect on teamwork	Presentations	Project kits
22	1,2,3	RFID Data Logging	- Read RFID UID - Store data in Google Sheets - Handle read errors - Discuss logging use cases	Mini Lecture	ESP32, RFID reader, server
23	2,3	Firebase Lamp Control	- Use Firebase REST/SDK - Sync cloud state with ESP32 - Control relay remotely - Verify feedback loop	Demo + Lab	ESP32, relay, Firebase
24	1,2,3	RFID with Firestore	- Read RFID UID - Write attendance records - Handle retries and failures - Validate stored data	Demo + Lab	ESP32, MFRC522/PN532

25	2,3,4	RFID Flask Dashboard	- Build Flask API endpoints - Display attendance tables - Filter records by date - Connect backend to Firestore	Code-along + Lab	Flask server, Firebase SDK
26	2,3,4,5	Dashboard Refinement	- Add CSV export feature - Apply attendance rules - Add charts and summaries - Document APIs	Lab + Mini Presentations	Same as Session 25
27	1,4,5	Final Project Planning & Hardware	- Define project scope - Design system architecture - Assemble hardware safely - Plan milestones	Design Studio	Planning templates, kits
28	2,3,4,5	Final Project Software & Cloud	- Implement core firmware - Select cloud platform - Add logging and alerts - Perform integration testing	Sprint Lab	Laptops, servers
29	3,4,5	Final Project Presentation (Day 1)	- Demonstrate working system - Defend design choices - Discuss security and power trade-offs - Answer technical questions	Presentations + Q&A	Slides, demo rigs
30	3,4,5	Final Project Presentation (Day 2)	- Continue demonstrations - Reflect on learning outcomes - Provide course feedback - Summarize key takeaways	Presentations + Reflection	Same as Session 29

Materials

Required Textbook

- Peter Waher (2022). *Mastering Internet of Things with ESP32: Practical IoT Development with Sensors, Actuators, and Cloud Platforms*. Packt Publishing.

Supplementary References

- Additional resources will be available on Canvas.
- Claus Kühnel (2021). *Getting Started with ESP32 Development Using MicroPython*. Elektor International Media.
- Pradeeka Seneviratne (2018). *Internet of Things with ESP32*. Packt Publishing.
- Peter Waher (2020). *Mastering Internet of Things: Design and Build IoT Solutions with Cloud Integration*. Packt Publishing.

Class Policy

Preparation

While we will have lectures, you are encouraged to be active in your learning and engage your classmates. The required reading may be demanding, challenging, and rigorous. However, we will devote class time to discussion and in-class activities. This will ensure that you maximize your opportunities to ask questions and engage your classmates through group activities. As such, ***it is important you do the reading before each class and come prepared to discuss the material.***

Behavior

Professional courtesy and etiquette are required at all times in the classroom. Please respect the right of other students not to be disturbed, distracted, or interrupted in their learning by your behavior. This includes:

- Punctuality reflects that you are respectful of everyone in class.
- Interruptions, private conversation, note passing, and texting are not allowed.
- Cell phones should be turned off or on silent mode.
- Electronic devices will be exclusively used for course related work.

- Participation in class discussion is an essential part of the class.

At the discretion of the professor, violations of the above may result in a penalty such as a grade reduction, being asked to leave class for the day, withdrawal from the course, and/or disciplinary action under the Student Code of Conduct.

Communication

It is essential for students to communicate to the instructor any needs, concerns, or questions as early as possible. I have posted certain office hours when I will be available to meet. If you need to meet outside of those times, you can always contact me for an appointment. Please note that any pertinent issues MUST be addressed early in the course before they become a serious hindrance to your coursework. Please do not hesitate to contact me if you have any concerns.

Attendance

Student attendance is essential for maximizing the value of the academic experience. Any student who is absent for 25% or more of class time will fail the class automatically.

Academic Integrity

Academic dishonesty will not be tolerated and is considered a serious offense. Academic integrity is a basic principle that requires all students to take credit only for the ideas and efforts that are their own. For incidents of plagiarism, the student will receive a warning, failure on the assignment, failure of the course, suspension, or expulsion—as determined by the professor and school dean. The professor may set up Turnitin for plagiarism check on specific Canvas assignments.

Students with Disability

AUPP is committed to making reasonable accommodations for students with disabilities. Students with any type of impairment that may make it difficult to succeed in this course are encouraged to inform the teacher as soon as possible in writing or through a private meeting. Any information will be kept confidential. Please note, however, that accommodation can only be granted in cases of a documented disability, and that you must request an accommodation before it can be given on any assignment, exam, or in-class activity.

***More policies** can be found in the AUPP Academic and Student Policies & Regulations.*