

College of San Mateo
Official Course Outline

1. **COURSE ID:** CIS 138 **TITLE:** Internet of Things

Units: 3.0 units **Hours/Semester:** 48.0-54.0 Lecture hours; and 96.0-108.0 Homework hours

Method of Grading: Grade Option (Letter Grade or Pass/No Pass)

Recommended Preparation:

Eligibility for ENGL 838 or ENGL 848 or ESL 400.
CIS 111, CIS 254

2. **COURSE DESIGNATION:**

Degree Credit

Transfer credit: CSU

AA/AS Degree Requirements:

CSM - GENERAL EDUCATION REQUIREMENTS: E2c.Communication and Analytical Thinking

3. **COURSE DESCRIPTIONS:**

Catalog Description:

Introduction to the emerging platform called the Internet of Things – wherein billions of devices communicate with each other and “the cloud”. Exploration of the convergence of multiple disciplines leading to modern Smartphones. Learn how information from physical devices in the real world gets communicated to Smartphone processors. Make informed design decisions about sampling frequencies and bit-width requirements for various kinds of sensors. Gain expertise to affect the real world with actuators such as stepper motors and LEDs, and generate notifications. Learn to interface common sensors and actuators to hardware. Develop software to acquire sensory data, process the data and actuate stepper motors, LEDs, etc. for use in mobile-enabled products. Apply analog-to-digital and digital-to-analog conversion concepts.

4. **STUDENT LEARNING OUTCOME(S) (SLO'S):**

Upon successful completion of this course, a student will meet the following outcomes:

1. Estimate sampling frequency and bit-width required for different sensors.
2. Program GPIOs (general purpose input/output pins) to enable communication between the hardware and common sensors.
3. Write data acquisition code for sensors such as passive and active infrared (IR) sensors, microphones, cameras, GPS, accelerometers, ultrasonic sensors, etc.
4. Write applications that process sensor data and take specific actions, such as stepper motors, LED matrices for digital signage and gaming.

5. **SPECIFIC INSTRUCTIONAL OBJECTIVES:**

Upon successful completion of this course, a student will be able to:

1. Estimate sampling frequency and bit-width required for different sensors.
2. Program GPIOs (general purpose input/output pins) to enable communication between the hardware and common sensors.
3. Write data acquisition code for sensors such as passive and active infrared (IR) sensors, microphones, cameras, GPS, accelerometers, ultrasonic sensors, etc.
4. Write applications that process sensor data and take specific actions, such as stepper motors, LED matrices for digital signage and gaming.

6. **COURSE CONTENT:**

Lecture Content:

1. IoT Concepts and Architectures
 - 1.1. Introduction
 - 1.2. Internet of Things definition evolution
 - 1.3. IoT architectures
 - 1.4. Resource management
 - 1.5. IoT data management and analytics
 - 1.6. Communication protocols
 - 1.7. Internet of Things applications
 - 1.8. Security

- 1.9. Identity management and authentication
- 1.10. Privacy
- 1.11. Standardization and regulatory limitations

2. Open source semantic web infrastructure for managing IoT resources in the Cloud
 - 2.1. Introduction
 - 2.2. Background/related work
 - 2.3. OpenIoT architecture for IoT/cloud convergence
 - 2.4. Scheduling process and IoT services lifecycle
 - 2.5. Scheduling and resource management
 - 2.6. Validating applications and use cases
 - 2.7. Future research directions

3. Device/Cloud collaboration framework for intelligence applications
 - 3.1. Introduction
 - 3.2. Background and related work
 - 3.3. Device/cloud collaboration framework
 - 3.4. Applications of device/cloud collaboration
 - 3.5. Future work

4. IoT Computing: principles, architectures, and applications
 - 4.1. Introduction
 - 4.2. Motivating scenario
 - 4.3. Definitions and characteristics
 - 4.4. Reference architecture
 - 4.5. Applications
 - 4.6. Research directions and enablers
 - 4.7. Commercial products
 - 4.8. Case study

5. Programming frameworks for Internet of Things
 - 5.1. Introduction
 - 5.2. Background
 - 5.3. Survey of IoT programming frameworks
 - 5.4. Future research directions

6. Virtualization on embedded boards as enabling technology for the Cloud of Things
 - 6.1. Introduction
 - 6.2. Background
 - 6.3. Virtualization and real-time
 - 6.4. Experimental results
 - 6.5. Future research directions

7. Micro Virtual Machines (MicroVMs) for Cloud-assisted Cyber-Physical Systems (CPS)
 - 7.1. Introduction
 - 7.2. Related work
 - 7.3. Architecture for deploying CPS in the Cloud and the expansion of the IoT
 - 7.4. Extending the possibilities of the IoT by Cloud Computing
 - 7.5. Micro Virtual Machines with the Sensor Observation Service, the path between smart objects and CPS
 - 7.6. IoT architecture for selected use cases

8. Stream processing in IoT: foundations, state-of-the-art, and future directions
 - 8.1. Introduction
 - 8.2. The foundations of stream processing in IoT
 - 8.3. Continuous Logic Processing System
 - 8.4. Challenges and future directions

9. A framework for distributed data analysis for IoT
 - 9.1. Introduction
 - 9.2. Preliminaries

- 9.3. Anomaly detection
- 9.4. Problem statement and definitions
- 9.5. Distributed anomaly detection
- 9.6. Efficient incremental local modeling

10. Security and privacy in the Internet of Things

- 10.1. Concepts
- 10.2. IoT security overview
- 10.3. Security frameworks for IoT
- 10.4. Privacy in IoT networks

11. Internet of Things—robustness and reliability

- 11.1. Introduction
- 11.2. IoT characteristics and reliability issues
- 11.3. Addressing reliability

12. Governing Internet of Things: issues, approaches, and new paradigms

- 12.1. Introduction
- 12.2. Background and related work
- 12.3. IoT governance
- 12.4. Future research directions

13. TinyTO: two-way authentication for constrained devices in the Internet of Things

- 13.1. Introduction
- 13.2. Security aspects and solutions
- 13.3. Design decisions
- 13.4. TinyTO protocol

14. Obfuscation and diversification for securing the internet of things (IoT)

- 14.1. Introduction
- 14.2. Distinguishing characteristics of IoT
- 14.3. Obfuscation and diversification techniques
- 14.4. Enhancing the security in IoT using obfuscation and diversification techniques
- 14.5. Different use-case scenarios on software diversification and obfuscation

15. Applied Internet of Things

- 15.1. Introduction
- 15.2. Scenario
- 15.3. Architecture overview
- 15.4. Sensors
- 15.5. Gateway
- 15.6. Data transmission

7. REPRESENTATIVE METHODS OF INSTRUCTION:

Typical methods of instruction may include:

- A. Lecture
- B. Activity
- C. Directed Study
- D. Discussion
- E. Experiments
- F. Observation and Demonstration

8. REPRESENTATIVE ASSIGNMENTS

Representative assignments in this course may include, but are not limited to the following:

Writing Assignments:

Students will be required to write documentation for IoT projects.

Reading Assignments:

Assigned readings in textbook(s) and additional online readings.

Other Outside Assignments:

IoT projects done using hardware such as Arduino, Galileo, Raspberry PI, or DragonBoard and various

sensors, motors, and LEDs.

9. REPRESENTATIVE METHODS OF EVALUATION

Representative methods of evaluation may include:

- A. Class Participation
- B. Class Work
- C. Exams/Tests
- D. Group Projects
- E. Homework
- F. Projects
- G. Quizzes
- H. Simulation
- I. Written examination

10. REPRESENTATIVE TEXT(S):

Possible textbooks include:

- A. Chou, T. *Precision: Principles, Practices and Solutions for the Internet of Things*, 1st ed. lulu.com, 2016
- B. Buyya, R. *Internet of Things: Principles and Paradigms*, 1st ed. Morgan Kaufmann, 2016
- C. Ramos, R. *Internet of Things Programming with JavaScript*, 1st ed. Packt Publishing, 2017
- D. Haines, D., Salguero, G., et al. *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things*, 1st ed. Cisco Press, 2017
- E. Pethuru, R., Raman, A. *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*, 1st ed. Auerbach Publications, 2017
- F. Chin, S., Weaver, J. *Raspberry Pi with Java: Programming the Internet of Things*, 1st ed. McGraw Hill Education, 2015

Other:

- A. Arduino, Galileo, Raspberry Pi, or DragonBoard hardware

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Course Originator: Melissa Green