# Course Specification

— (Bachelor)

| | |
|---|---|
| **Course Title**: Internet of Things | |
| **Course Code**: CEN 1413 | |
| **Program**: bachelor in Computer Engineering | |
| **Department**: Computer Engineering | |
| **College**: Faculty of Computer and Information Technology | |
| **Institution**: University of Tabuk | |
| **Version**: 1.0 | |
| **Last Revision Date**: 27 July 2022 | |

## Table of Contents

## A. General information about the course:

### 1. Course Identification

**1. Credit hours: ( 3 )**

**2. Course type**

| A. | ☐ University | ☐ College | ☒ Department | ☐ Track | ☐ Others |
|---|---|---|---|---|---|
| B. | ☐ Required | | ☒ Elective | | |

**3. Level/year at which this course is offered: (10/5)**

**4. Course general Description:**

This course describes the fundamental concepts of IoT that includes the Evolution of Internet of Things, Enabling Technologies, IoT Architectures and etc. In addition, it focuses on different IoT protocols of Physical, MAC, Network, Transport and Application Layers. The design and development of the IoT, data analytics and supporting services of Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine Learning, No SQL Databases, Hadoop Ecosystem, Apache Kafka, Apache Spark, Edge Streaming Analytics, Network Analytics and some of the Case Studies/Industrial Applications are also focused on this course.

**5. Pre-requirements for this course (if any):**

CEN 1405

**6. Co-requisites for this course (if any):**

N/A

**7. Course Main Objective(s):**

- To understand Smart Objects and IoT Architectures.
- To learn about various IoT-related protocols.
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT.
- To develop IoT infrastructure for popular applications.

### 2. Teaching mode (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 45 | 100% |
| 2 | E-learning | - | - |
| 3 | Hybrid <br> • Traditional classroom <br> • E-learning | - | - |

| No | Mode of Instruction | Contact Hours | Percentage |
|----|---------------------|---------------|------------|
| 4 | Distance learning | - | - |

## 3. Contact Hours (based on the academic semester)

| No | Activity | Contact Hours |
|----|----------|---------------|
| 1. | **Lectures** | 45 |
| 2. | **Laboratory/Studio** | - |
| 3. | **Field** | - |
| 4. | **Tutorial** | - |
| 5. | **Others (specify)** | - |
| **Total** | | 45 |

## B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Code of PLOs aligned with program | Teaching Strategies | Assessment Methods |
|------|--------------------------|-----------------------------------|---------------------|--------------------|
| **1.0** | **Knowledge and understanding** | | | |
| 1.1 | To understand the fundamentals, evolution, architecture of IOT | K1 | Lectures, textbooks, provided handouts, references. | Exams, quizzes, assignments |
| 1.2 | To understand the IoT protocols of Application, Transport, Network, MAC and physical layers | K1 | | |
| 1.3 | To understand the different hardware's functionalities that support to develop the IoT such as Sensors, Raspberry pi/Arduino and etc. | K1 | | |
| 1.4 | To understand data analytics and cloud in the context of loT. | K3 | | |
| 1.5 | To study the language: Python. | K2 | | |
| **2.0** | **Skills** | | | |
| 2.1 | Analyze various protocols for loT. | S1 | | Exams, quizzes, assignments |

| Code | Course Learning Outcomes | Code of PLOs aligned with program | Teaching Strategies | Assessment Methods |
|------|--------------------------|-----------------------------------|---------------------|--------------------|
| 2.2 | Design a PoE of an IoT system using Raspberry pi /Arduino | S1 | Lectures, textbooks, provided handouts, references. | |
| 2.3 | Apply data analytics and use cloud offerings related to IoT | S3 | | |
| 2.4 | Analyze applications of IoT in real time scenario. | S3 | | |
| **3.0** | **Values, autonomy, and responsibility** | | | |
| 3.1 | Acquire and demonstrate the professional and ethical issues in Data Management. | V2 | Lectures, textbooks, provided handouts, references. | Exams, quizzes, assignments |
| 3.2 | The ability to demonstrate work within a team. | V2 | | |

## C. Course Content

| No | List of Topics | Contact Hours |
|----|----------------|---------------|
| 1. | Fundamentals Of IoT: Evolution of Internet of Things - Enabling Technologies | 3 |
| 2. | IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models | 3 |
| 3. | Simplified IoT Architecture and Core IoT Functional Stack - Fog, Edge and Cloud in IoT | 3 |
| 4. | Functional blocks of an IoT ecosystem - Sensors, Actuators, Smart Objects and Connecting Smart Objects | 3 |
| 5. | IoT Access Technologies: Physical and MAC layers | 3 |
| 6. | IoT Access Technologies: topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11 ah and LoRaWAN | 3 |
| 7. | Network Layer: IP versions, Constrained Nodes and Constrained Networks | 3 |
| 8. | Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks | 3 |
| 9. | Application Transport Methods: Supervisory Control and Data Acquisition Application Layer Protocols: CoAP and MQTT | 3 |
| 10. | Design Methodology - Embedded computing logic - | 3 |
| 11. | Microcontroller, System on Chips - IoT system building blocks | 3 |
| 12. | Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming | 3 |
| 13. | Structured Vs Unstructured Data and Data in Motion Vs Data in Rest - Role of Machine Learning | 3 |
| 14. | No SQL Databases - Hadoop Ecosystem - Apache Kafka, Apache Spark - Edge Streaming Analytics and Network Analytics | 3 |
| 15. | Case Studies/Industrial Applications | 3 |

| Total | 45 |
|-------|-----|

## D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|----|------------------------|-------------------------------|--------------------------------------|
| 1. | Two Assignments | 5,14 | 10% |
| 2. | Two Quizzes | 4,9 | 10% |
| 3. | Two Midterm Exam | 7,12 | 40% |
| 4. | Final Exam | 16 | 40% |

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

## E. Learning Resources and Facilities

### 1. References and Learning Resources

| Essential References | David Hanes, Gonzalo Salgueiro, Patrick Grossetete. Rob Barton and Jerome Henry, ''loT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017. |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Supportive References | ▪ Arshdeep Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach‖, Universities Press, 2015<br>▪ Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach‖, Universities Press, 2015 |
| Electronic Materials | https://www.arduino.cc/<br>https://www.ibm.com/smarterplanet/us/en/?ca=v smarterplanet |
| Other Learning Materials | - |

### 2. Required Facilities and equipment

| Items | Resources |
|-------|-----------|
| **facilities**<br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | Classroom |
| **Technology equipment**<br>(projector, smart board, software) | Data show |
| **Other equipment**<br>(depending on the nature of the specialty) | TBA |

## F. Assessment of Course Quality

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Effectiveness of Teaching | Faculty, Program Leaders, and Advisory Board | Both Direct and Indirect |
| | Students | Indirect |
| Effectiveness of Students Assessment | Faculty, Program Leaders, Advisory Board, and Independent Opinion | Both Direct and Indirect |
| Quality of Learning Resources | Faculty, Students, and Advisory Board | Indirect |
| The Extent to which CLOs have been Achieved | Faculty, Program Leaders, Advisory Board, and Independent Opinion | Direct (as in section B) and Indirect/Surveys |
| | Students | Indirect |
| Other | - | - |

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

## G. Specification Approval

| COUNCIL /COMMITTEE | |
|---|---|
| REFERENCE NO. | |
| DATE | |