Introduction to IoT using Arduino

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title and Code	Credits	Credit distribution of the course			Eligibility Criteria	Prerequisite of the Course (if any)
		Lecture	Tutorial	Practical/ Practice		
Introduction to IoT using Arduino	2	0	0	2	XII pass	Basic Knowledge of any Programming Language

1. Learning Objectives

- To introduce students to the fundamentals of the Internet of Things (IoT).
- To enable hands-on experience with Arduino.
- To develop basic to advanced IoT applications using sensors, actuators, and cloud platforms.

2. Learning Outcomes

By the end of the course, students will:

- Understand IoT fundamentals and Arduino programming.
- Interface various sensors and actuators for IoT applications.
- Develop real-world IoT solutions with cloud integration.
- Implement IoT projects.

3. Main Course Structure

Unit 1: Introduction to IoT & Arduino (Weeks 1-4) **[16 Hours]**

Introduction to IoT and Arduino: Basics of IoT, its components, and real-world applications. Introduction to Arduino board (Uno/Nano). Overview of Arduino IDE and basic coding structure.

Interfacing Basic Components: Understanding Digital and Analog I/O. Hands-on with LEDs, Buzzers, and Switches using Arduino. Introduction to Serial Communication (UART, SPI, I2C).

Unit 2: Working with Sensors & Actuators (Weeks 5-8) **[16 Hours]**

Analog & Digital Sensors: Difference between Analog and Digital Sensors, Sensor Characteristics. Various kinds of sensors for different IoT applications: LM35, DHT11 sensor for Temperature and Humidity; Light Sensor (LDR) for detection of light intensity; InfraRed Sensor (IR) for Motion and object detection; Ultrasonic Sensor for

distance measurement; Gas Sensor MQ-135 for air quality; Accelerometer and Gyroscope, magnetometer Sensors. Displaying sensor data on Serial Monitor and on Interfaced LCD screen/TFT screen.

Actuators: Motors like DC, Servo, Stepper to create motion. Relays to Control switching on/off of Electrical Appliances.

Unit 3: IoT Communication & Cloud Integration (Weeks 9-12) [16 Hours]

Introduction to Wireless Communication (Wi-Fi & Bluetooth): Introduction to Wi-Fi, Bluetooth, and MQTT Protocols. Basics of ESP8266 Wi-Fi Module and HC-05 Bluetooth Module. Sending simple data over Bluetooth and Wi-Fi.

IoT Cloud Platforms & Data Storage: Introduction to cloud platforms for IoT applications. Sending Sensor Data to the Cloud Dashboard.

Remote Monitoring & Control: Retrieving sensor data from the Cloud Dashboard. Controlling Arduino remotely using Mobile App.

Unit 4: Hands-on IoT Mini Project and Presentations (Week 13-15) [12 Hours]

Demo of Arduino-Based Mini Projects by Students (including but not limited to):

- Motion-Based Security Alarm
- IoT-Based Weather Station
- Bluetooth-Controlled Home Automation
- Ultrasonic-Based Smart Parking System
- IoT-Based Intruder Alert System
- Smart Dustbin
- Heart Rate Monitor using Pulse Sensor
- IoT-Based Fire Detection System

Practical List:

Study the Arduino board and install Arduino IDE and configure it for Arduino Uno/ Nano. Perform the following experiments on Arduino board:

P1. Write a program to blink an LED with an interval of one second.

P2. Write a program to continuously create a fading effect in an LED using PWM (Pulse Width Modulation).

P3. Write a program to turn the LED ON when the button is pressed and OFF when released.

P4. Write a program to activate the buzzer when the button is pressed.

P5. Write a program to read analog sensor values of LDR and display them on the serial monitor/ LCD.

P6. Write a program to measure the light intensity with LDR and turn an LED ON/OFF based on threshold.

P7. Write a program to read the temperature values using analog sensor LM35, calculate the temperature in Celsius and Fahrenheit and display on serial monitor/ LCD.

P8. Write a program to read the values of ultrasonic sensor, calculate the distance to an object and display the distance on serial monitor/ LCD.

P9. Write a program to read the values from a smoke sensor, calculate the gas concentration in parts per million (PPM), and display the reading along with "Safe" or "Unsafe" messages based on the threshold, on the serial monitor/ LCD.

P10. Write a program to read the values from accelerometer, gyroscope, and magnetometer modules and display the values on serial monitor/ LCD.

P11. Write a program to read the values of temperature and humidity using digital sensor DHT11 and display the values on serial monitor/ LCD.

P12. Write a program to interface a DC Motor with a motor driver (L293D) to control its rotation direction (clockwise/anticlockwise) with button presses.

P13. Write a program to interface a DC Motor with a motor driver (L293D) to control the speed of motor using Pulse Width Modulation (PWM).

P14. Write a program to interface a servo motor with Arduino and rotate it to specific angles: 0°, 90°, and 180°.

P15. Write a program to interface a relay module with Arduino to control the turning ON and OFF of a 220V bulb when an LDR detects darkness/ brightness.

P16. Write a program to simulate a traffic light sequence (Red → Green → Yellow) using LEDs.

P17. Write a program to interface a Bluetooth module HC-05 with Arduino and send "1"/"0" commands from the mobile phone to control an LED ON/ OFF.

P18. Write a program to interface a Bluetooth module HC-05 with Arduino and send any sensor data (e.g., temperature, light intensity) from Arduino to mobile phone.

P19. Write a program to connect ESP8266 Wi-Fi module to Arduino. Send temperature and humidity data from DHT11 or any other sensor data, to and from a cloud dashboard. Monitor live sensor data on a cloud dashboard.

4. Teaching Methodology/Activities in the classroom: After completion of each unit student will be engaged in the hands-on activity involving the IoT concept taught. The use cases pertaining to industry will be discussed.
5. Assessment Pattern for each Unit/practical. Component of Attendance in the Assessment of 1 credit theory course: As per University guidelines for SEC courses.
6. Mapping with the next suggestive course: After their confluence with IoT course they can be engaged in exploring more IoT microcontrollers. Next suggestive course can be framed on Advanced IoT using Raspberry Pi.
7. Prospective Job Roles after a particular course: Students with relevant skill sets in IoT tools with job opportunities in roles such as IoT Developer – Designing and implementing IoT applications, Embedded Systems Engineer – Working with microcontrollers and IoT hardware, Cloud IoT Engineer – Managing IoT data on cloud platforms, Automation Engineer – Implementing smart automation solutions using IoT etc.
8. Essential Readings:

- "Introduction to IoT" Sudip Misra, Anandarup Mukherjee, and Arijit Roy. Cambridge University Press
- "Arduino Cookbook: Recipes to Begin, Expand, and Enhance Your Projects" by Michael Margolis, Brian Jepson, and Nicholas Robert Weldin. O'Reilly Books

9. Suggestive Reading:
   - "The Internet of Things" by Samuel Greengard. The MIT Press
   - www.arduino.cc
   - www.thingsboard.io