Answer all questions in all sections.

**Section A (50 marks)**

1. Define and describe the terminology of an IoT system. (7 marks)

Internet of Things is a system of interconnected sensor devices, which allows remote controlling and monitoring. Its main purpose is to increase ease of use and speed up operations of dedicated systems. Its application is fairly broad in internet-based systems, such as education, smart home, logistics, traffic system, surveillance system, warehouse, manufacturing, weather stations, satellites, and robotics. Different sensors are interconnected to a microcontroller unit, which is a programmable chipset that is used to control different types of sensor components.

2. Discuss four advantages and four disadvantages of an IoT system. (8 marks)

**Advantages:**

- Possible usage of HTTPs connection for secure communication

- System is scalable

- Collection of real time data

- Inexpensive development and deployment

**Disadvantages:**

- Inability to perform port forwarding or port mapping for certain routers

- High network latency for fixed routes

- Possible usage of insecure HTTP which allow man-in-the-middle attacks

- Costly to store large amount of incoming sensor data

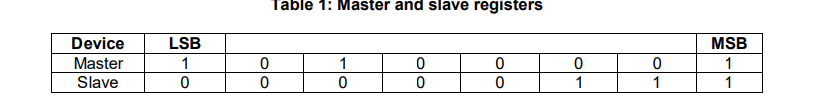
3. Given two bit streams for master and slave registers below at time, t = 0, show the data

representations for a byte of transfer in the MOSI line of SPI interface. (8 marks)

Table 1: Master and slave registers

Correction in table:

LSB -> MSB, MSB -> LSB



Step:

1. Master:11010000

Slave:10000011

1. Master:11101000

Slave:01000001

1. Master:11110100

Slave:00100000

1. Master: 01111010

Slave: 00010000

1. Master: 00111101

Slave: 00001000

1. Master: 00011110

Slave: 10000100

1. Master: 00001111

Slave: 01000010

1. Master: 00000111

Slave: 10100001

**Correct:**

|  |  |  |
| --- | --- | --- |
| Step | Master | Slave |
| 0 | 10100001 | 00000111 |
| 1 | 01000010 | 00001111 |
| 2 | 10000100 | 00011110 |
| 3 | 00001000 | 00111101 |
| 4 | 00010000 | 01111010 |
| 5 | 00100000 | 11110100 |
| 6 | 01000000 | 11101000 |
| 7 | 10000000 | 11010000 |
| 8 | 00000000 | 10100001 |

4. Name and discuss four characteristics of a service-oriented architecture (SOA). (12 marks)

Interoperability – SOA supports cross platform usage to deal with the heterogeneity of components

Distributed – SOA components are loosely coupled, giving more autonomy to service providers and form a load balancing mechanism

Abstraction – It hides away service implementation details, allowing consumers to use the service to handle the complex system without needing to know how they work.

Standard – Service contractors conforms to the same standards defined for SOA services.

5. Identify and discuss five service components involved for an airport IoT system. (15 marks)

-Aerial traffic control. Airport may need an IoT system to control on-going flights to ensure they do not stray from the flight route and prevent collisions.

-Flight staff management. Airport may need an IoT system to manage information of all the staff that is available for duty in the airport.

-Freight tracking. Airport may need an IoT system to track commercial loads that are transported by flight.

-Flight tracking. Airport may need an IoT system to track the location and speed of flying planes to estimate arrival times.

-Ticket tracking. Airport may need an IoT system to track the amount of available tickets left for a certain flight to show flight availability.

**Section B (50 marks)**

1. Write an Arduino code to read two strings of characters; firstName and lastName. (10 marks)

String firstName, lastName;

Void setup() {

Serial.begin(9600);

Serial.println(“Enter first name: “);

while(Serial.available() != 0);

firstName = Serial.readString();

Serial.println(“Enter last name: “);

while(Serial.available() != 0);

lastName = Serial.readString();

}

2. Draw the I2C connections for two microcontroller units (MCUs). (8 marks)

MCU1 MCU2

SDA SDA

SCL SCL

Draw in diagram

6 marks for label

2 marks for connection

3. Write a complete Arduino code to increase the intensity of a light-emitting diode (LED) that

connects to a pulse-width modulation (PWM) pin of a MCU, with a step size of 16 for every two

seconds. (13 marks)

const int ledPin = D5;

bool isLedOn = false;

void setup() {

pinMode(ledPin, OUTPUT);

}

void loop() {

if (!isLedOn) {

digitalWrite(ledPin, HIGH);

isLedOn = true;

} else {

digitalWrite(ledPin, LOW);

isLedOn = false;

}

delay(2000);

}

Int ledPin = D5;

Int intensity = 255; // 2 bytes

Void setup() {

pinMode(ledPin, OUTPUT);

}

Void loop() {

analogWrite(LED\_PIN, intensity);

intensity += 16;

if (intensity >= 255) intensity = 0;

delay(2000);

}

4. Write a function in Arduino code to connect a MCU to a wireless local area network (WLAN) with

a service set identifier (SSID), “Adam” and a password, “Eve@123”. Then, verify if there is a

network coverage for this WLAN. (12 marks)

const char\* SSID = “Adam”;

const char\* PASSWORD = “Eve@123”;

void connectWLAN() {

Serial.begin(9600);

WiFi.begin(SSID, PASSWORD);

while (WiFi.status() != WL\_CONNECTED) {

Serial.print(‘.’);

}

Serial.println(“Connected to WiFi.”);

}

void connectWLAN() {

WiFi.begin(SSID, PASSWORD);

while (WiFi.status() != WL\_NO\_SSID\_AVAIL) {

Serial.print(“There is no SSID available.”);

}

}

5. Fill in the blanks for the configuration of message queue telemetry transport (MQTT) protocol

below. (7 marks)

const char\* mqttServer = "io.com";

const char\* serverPort = "8080";

WiFiClient espClient;

Adafruit\_MQTT client(serverPort);

void setup(){

\_\_\_(espClient, serverPort);

\_\_\_(callback);

}

const char\* mqttServer = "io.com";

const char\* serverPort = "8080";

**WiFiClient** espClient;

**PubSubClient** client(**espClient**);

void setup(){

**client.setServer**(**mqttServer**, **serverPort**);

**client.setCallback**(callback);

}