CET3063/N/CET3064 Internet of Things
Final Exam Answer Script
September 2022
Set A

Section A (50 marks)

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

Internet of Things. **(1 mark)**

- ✓ It is a system which connects the relevant devices to perform operations, such as control, monitor, optimise, and make prediction. **(2 marks)**
- ✓ Main purpose is for ease of use and speed up the operations of a dedicated system. **(2 marks)**
- ✓ Its application is fairly broad to Internet-based system, which involved education, medical, smart home, logistics, traffic system, surveillance system, warehouse, manufacturing, weather stations, robotics, satellites, and so on. **(2 marks)**

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

Advantages	**Disadvantages**
Usage of HTTPs or encrypted network communication.	Usage of HTTP and non-encrypted network communication could allow man-in-the-middle attacks.
It is scalable.	Difficult to do port forwarding or port mapping for certain routers.
It could provide real-time data collection and monitoring in local area network (LAN).	High network latency could occur if fixed route has configured.
Open source and independent from vendors.	Closed system and dependent for certain brands or vendors.
Relatively cheap to develop and deploy.	It could be expensive to store big data incoming from sensors.

1 mark will be awarded for each correct advantage above, maximum four only.
1 mark will be awarded for each correct disadvantage above, maximum four only.

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

MSB LSB

Device	**LSB**							**MSB**
Master	1	0	1	0	0	0	0	1
Slave	0	0	0	0	0	1	1	1

T	**Master**	**Slave**	
0	10100001	00000111	
1	01000010	00001111	**(1 mark)**
2	10000100	00011110	**(1 mark)**
4	00001000	00111101	**(1 mark)**
5	00010000	01111010	**(1 mark)**
6	00100000	11110100	**(1 mark)**
7	01000000	11101000	**(1 mark)**
8	10000000	11010000	**(1 mark)**
9	00000000	10100001	**(1 mark)**

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

Characteristics	Explanations
Interoperability **(1 mark)**	It supports cross-platform to deal with the high level of diversity between components. **(2 marks)**
Distributed **(1 mark)**	It is loosely couple, which gives the autonomy for the service providers, while form a load balancing mechanism. **(2 marks)**
Abstraction **(1 mark)**	It adds the layers of encapsulation, such as model, view, and control (MVC) pattern to handle the complex and huge system. **(2 marks)**
Standard **(1 mark)**	Service contractors use the same generic definitions for system integration. **(2 marks)**

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

Service	Discussion
Information center	It handles flight related inquiries, ticketing, and travel guidance.
Consignment system	It is a check-in and drop off system which filters, transfer, and tracks the luggage and cargo.
Immigration counters and security	It is a security checking system which scans and controls the flow of people in the airport.
Air traffic control (ATC)	It monitors and controls the movements of aircrafts for departure and landing procedures in the runways.
Fire and rescue	It provides emergency supports when accident happened to the airport and aircrafts.

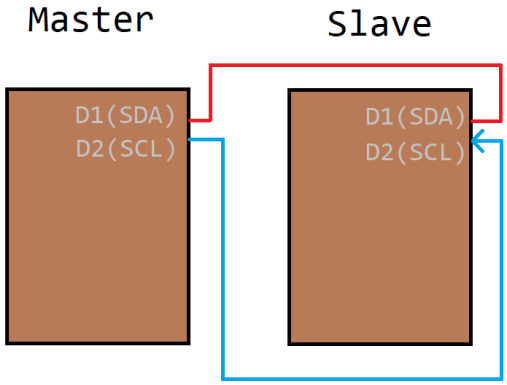
1 mark will be awarded for a valid service in the airport such as above, maximum five only.
2 marks will be awarded for each corresponding discussion, maximum five only.

Section B (50 marks)

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

```
String firstName, lastName; (2 marks)
void setup(){ (1 mark)
  Serial.begin(9600); (1 mark)
  Serial.println("Enter your first name: "); (1 mark)
  while(Serial.available() == 0); (1 mark)
  firstName = Serial.readString(); (1 mark)
  Serial.println("Enter your last name: "); (1 mark)
  while(Serial.available() == 0); (1 mark)
  lastName = Serial.readString(); (1 mark)
}
```

2) Draw the I^2C connections for two microcontroller units (MCUs). (8 marks)



1 mark will be awarded for each correct label, six in total.
1 mark will be awarded for each correct connection, two in total.

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)

```
int LED_PIN = 5; (1 mark)
int intensity = 1023; (1 mark)  255
void setup(){ (1 mark)
  pinMode(LED_PIN, OUTPUT); (2 marks)
}
void loop(){ (1 mark)
  analogWrite(LED_PIN, intensity); (2 marks)
  intensity += 16; (2 marks)          0
  if(intensity >= 255) intensity = 1023; (2 marks)
  delay(2000); (1 mark)
}
```

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"; (2 marks)
const char* password = "Eve@123"; (2 marks)

void connectWLAN(){ (1 mark)
 WiFi.begin(ssid, password); (3 marks)
 while(WiFi.status() != WL_NO_SSID_AVAIL) { (2 marks)
  delay(500); (1 mark)
  Serial.print("There is no SSID available."); (1 mark)
 }
```

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 = "1888"; 8080
WiFiClient espClient; (1 mark)
PubSubClient client(espClient); (2 marks)

void setup(){
  client.setServer(mqttServer, serverPort); (3 mark)
  client.setCallback(callback); (1 mark)
}
```

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