UNIVERSITI TEKNOLOGI PETRONAS

FINAL EXAMINATION
MAY 2024 SEMESTER

COURSE : TEB2203/TFB2093 - INTERNET OF THINGS (IOT)

DATE : 7 AUGUST 2024 (WEDNESDAY)

TIME : 2:30 PM - 5:30 PM (3 HOURS)

INSTRUCTIONS TO CANDIDATES

1. Answer **ALL** questions in the Answer Booklet.
2. Begin **EACH** answer on a new page in the Answer Booklet.
3. Indicate clearly answers that are cancelled, if any.
4. Where applicable, show clearly steps taken in arriving at the solutions and indicate **ALL** assumptions, if any.
5. **DO NOT** open this Question Booklet until instructed.

Note :

i. There are **SIX (6)** pages in this Question Booklet including the cover page

ii. **DOUBLE-SIDED** Question Booklet.

1. a. Describe **FIVE (5)** significant differences between Harvard Architecture and Von Neumann Architecture.

[5 Marks]

b. In the context of embedded systems and IoT, elaborate the role of Gyroscopes, Accelerometers, Temperature Sensors, Wearable Sensors, and Proximity Sensors.

[5 Marks]

c. You are tasked with designing a Finite State Machine (FSM) to model the behavior of an autonomous drone in a search and rescue mission. The FSM should allow the drone to:

- Navigate efficiently through a disaster area.
- Identify survivors.
- Deliver medical supplies.
- Return to its base for recharging and maintenance when necessary.
- Handle error conditions like communication loss or equipment malfunctions.

i. Analyse the provided scenario to identify and categorize the potential states and transitions managed by the delivery drone.

[3 Marks]

ii. Construct a detailed State Transition Table outlining the identified states and transitions from **part (c)(i)** for the delivery drone scenario.

[3 Marks]

iii. Develop a visual Finite State Machine (FSM) based on the State Transition Table from **part (c)(ii),** for illustrating the identified states and transitions for the delivery drone scenario.

[4 Marks]

2. a. You are tasked with designing a temperature sensing system using an Arduino IoT node, as shown in **FIGURE Q2**. The system incorporates a **TMP36** temperature sensor, which provides raw temperature values ranging from 0 to 1023. Your objective is to integrate this sensor into the IoT node (breadboard) to accurately detect and monitor temperature changes in a given environment. Analyze this design and ensure the system operates effectively for its intended application.

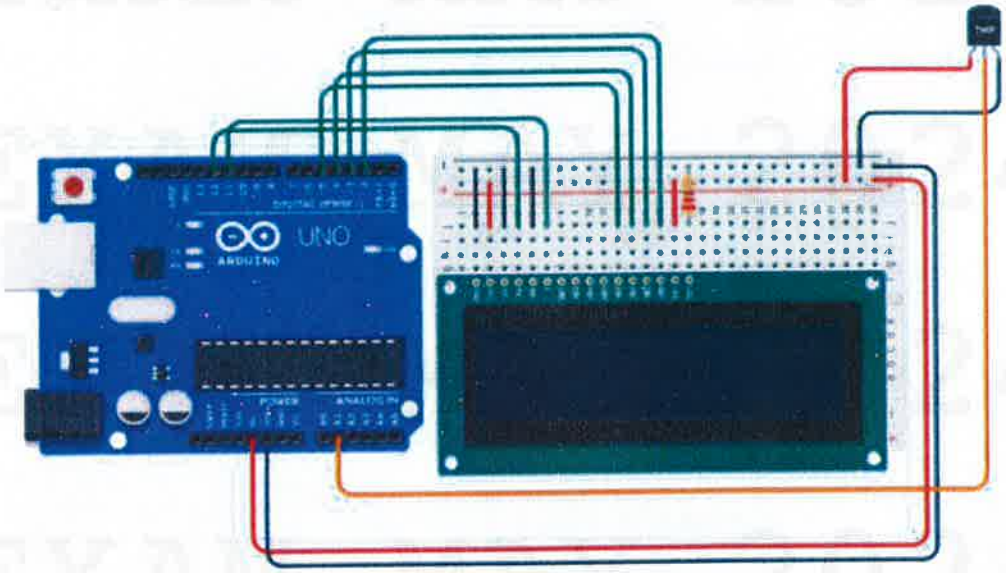

FIGURE Q2: Temperature Sensing System with TMP36

[8 Marks]

b. Create a well-defined and appropriately labeled schematic diagram based on **FIGURE Q2**.

[6 Marks]

d. Develop a full Arduino sketch (program) to:

- measure/read the raw temperature value at 2-second intervals,
- convert the raw temperature value to a range of 0°C to 100°C,
- show both the raw and the converted values on an LCD display.

[6 Marks]

3. a. Describe the following built-in Arduino IoT functions and provide an appropriate Arduino example for each.

i. `pinMode( )`

[3 Marks]

ii. `digitalWrite( )`

[3 Marks]

iii. `analogRead( )`

[3 Marks]

iv. `constrain(x, a, b)`

[3 Marks]

b. Determine the resulting output in the provided Arduino code to illustrate converting float point numbers to integers.

```
float x = 2.9;
int y = x;
```

[4 Marks]

c. Consider the scenario where IoT *sensor_X* receives the pattern 1234.567 for storage and processing. Evaluate the processing of this received pattern using the concepts of mantissa and exponent in floating-point representation.

[4 Marks]

4. The circuit depicted in **FIGURE Q4** shows an Arduino board to control an LED, with the support of a resistor.

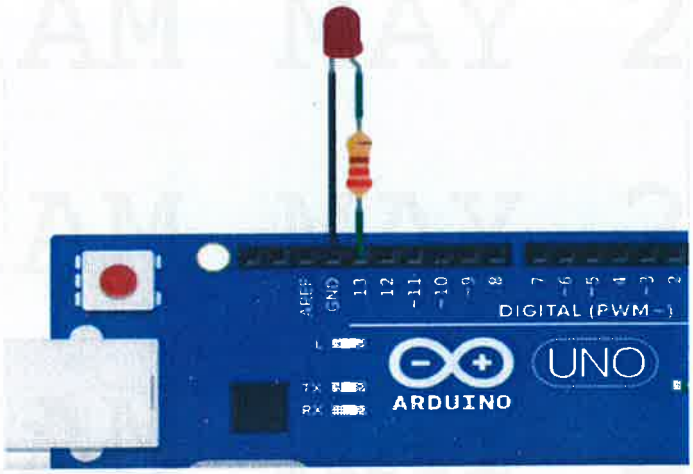

FIGURE Q4: Blinking an LED

a. Develop a comprehensive Arduino sketch to blink this LED and subsequently elucidate the code's functionality and purpose.

[10 Marks]

b. Write a complete Arduino sketch to perform the following arithmetic operations in the sketch.

- Addition
- Subtraction
- Multiplication
- Division
- Modulus
- Increment `(++)`
- Decrement `(--)`

[10 Marks]

5. Consider **FIGURE Q5** that illustrates the circuit for controlling a 7-segment display unit using Arduino board.

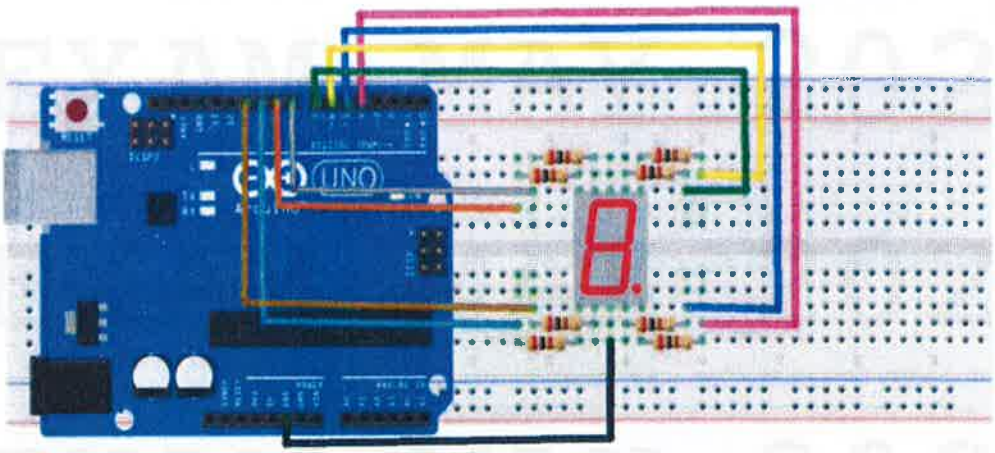

FIGURE Q5: 7-Segment Display Circuit

Assume the following array was declared earlier:

```
const int segment7[8] = {1, 2, 3, 4, 5, 6, 7, 8}
```

a. Write function `void setup()` to set up the necessary pins for controlling the 7-segment display unit.

[8 Marks]

b. Write function `void loop()` to light up the segments one-by-one with the interval of 1000 milliseconds.

[5 Marks]

c. Develop an Arduino sketch that uses the `min()` and `max()` functions to find the minimum and maximum values from a set of numbers.

[7 Marks]

– END OF PAPER –