UNIVERSITI TEKNOLOGI PETRONAS

FINAL EXAMINATION
JANUARY 2025 SEMESTER

COURSE : TEB2053 - EMBEDDED SYSTEM

DATE : 14 APRIL 2025 (MONDAY)

TIME : 9:00 AM - 12:00 NOON (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. For fundamental concepts of Embedded Systems (ES) and the Internet of Things (IoT), it is important to understand their differences, and how IoT is applied across various industries. The role of IoT in improving efficiency is important, along with security concerns and effective use cases that can impact IoT networks.

i. Describe **TWO (2)** key differences between Embedded Systems (ES) and the Internet of Things (IoT).

[6 marks]

ii. Give **TWO (2)** examples of industries where IoT is widely used and explain how it improves efficiency in each industry.

[6 marks]

b. Security consideration is important when implementing IoT systems. Justify why security is a major concern in IoT applications. Provide **TWO (2)** reasons.

[8 marks]

2. a. **FIGURE Q2** shows the structure of IoT architecture, including sensors and actuators, internet gateways and data acquisition systems, Edge/Processing, and cloud computing.

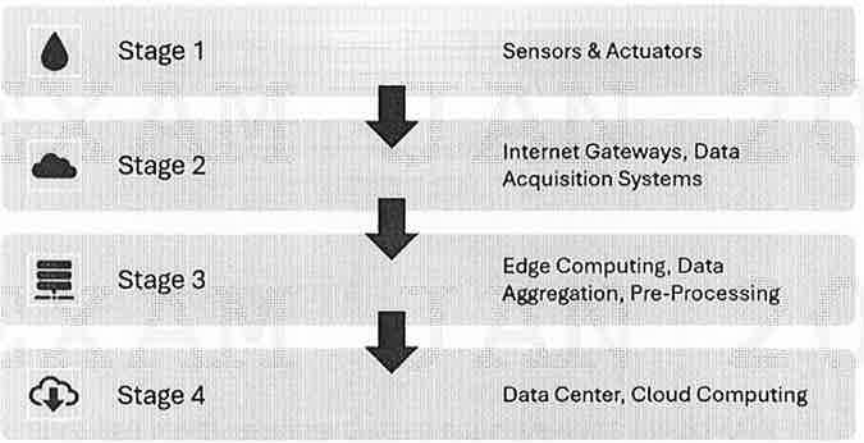

FIGURE Q2: IoT Stage Architecture

i. Discuss the four main layers of IoT architecture and their functions shown in **FIGURE Q2**.

[8 marks]

ii. Suggest **TWO (2)** wireless communication protocols used in IoT and explain their advantages.

[4 marks]

b. Explain the following terms, along with their examples.

i. Bits

ii. Bytes

iii. Memory Cells

iv. Floating Point

[8 marks]

3. a. Explain the importance of microcontrollers in IoT devices by mentioning **TWO (2)** key functions of microcontrollers.

[4 marks]

b. Describe **TWO (2)** differences between Analog-to-Digital Converters (ADC) and Pulse Width Modulation (PWM) in IoT applications.

[4 marks]

c. **FIGURE Q3** shows Arduino UNO pinouts. Each has their own functions.

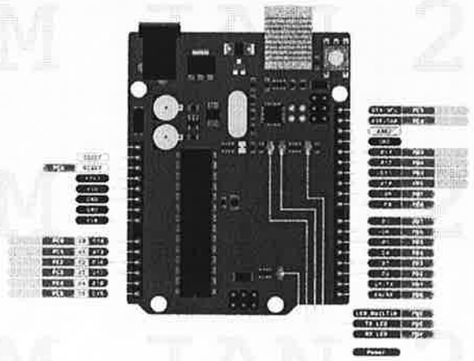

FIGURE Q3: Arduino UNO Connector Pins

i. Based on **FIGURE Q3**, describe how to create two blinking LEDs project by using power pin 3V/5V, GND, General-Purpose-Input-Output (GPIO) pins, and *delay()* function.

[6 marks]

ii. Give **TWO (2)** examples of projects using Arduino UNO using at least one sensor and one actuator such as temperature sensors, humidity sensors, light sensors, DC motors and LEDs.

[6 marks]

4. a. **FIGURE Q4** shows an example of a state transition diagram which represents a finite-state machine.

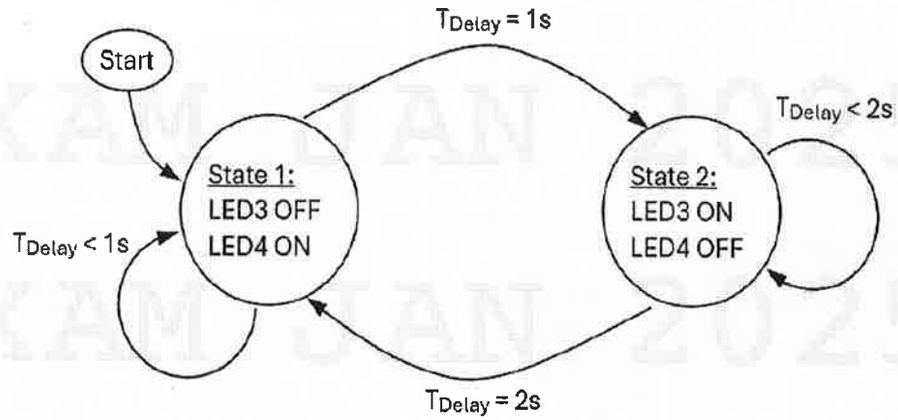

FIGURE Q4: Example of state transition diagram.

i. Explain the mechanism of the system shown in **FIGURE Q4**.

[10 marks]

ii. Modify and redraw the state transition in **FIGURE Q4**, so that when LED 3 is ON and LED 4 is OFF, it will transit to a new state where both LEDs will be OFF after 3 seconds and return to State 1 after 5 seconds. Give justification on your new state transition diagram.

[10 marks]

5. a. Explain the key components such as actuators, sensors, edge computer and cloud computing services with respect to designing an IoT-based monitoring and control system.

[6 marks]

b. Justify **TWO (2)** advantages of edge computing over cloud computing.

[8 marks]

c. Describe how you can use pulse-width-modulation (PWM) by adjusting the frequency of the microchip timers to control the speed of a DC motor.

[6 marks]

- END OF PAPER -