

**UNIVERSITY COLLEGE TATI (UC TATI)****FINAL EXAMINATION QUESTION BOOKLET**

COURSE CODE	: BMT 4033
COURSE	: EMBEDDED SYSTEM DESIGN
SEMESTER/SESSION	: 1-2022/2023 (FLEXIBLE)
DURATION	: 3 HOURS

Instructions:

1. This booklet contains 4 questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 10 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

Refer to the circuit in Figure 1. The circuit need to operate according to the following sequence:

- If the button is pressed, turn on each LED in the following order:
 1. Red LED on and display character " r " on the 7-segment for 5 seconds.
 2. Yellow LED on and display character " Y " on the 7-segment for 3 seconds.
 3. Green LED on and display character " G " on the 7-segment for 5 seconds.
- If the button is not pressed, no LEDs should turn on and display a blinking character dash (" – ") on the 7-segment.

Produce a program to run the operation.

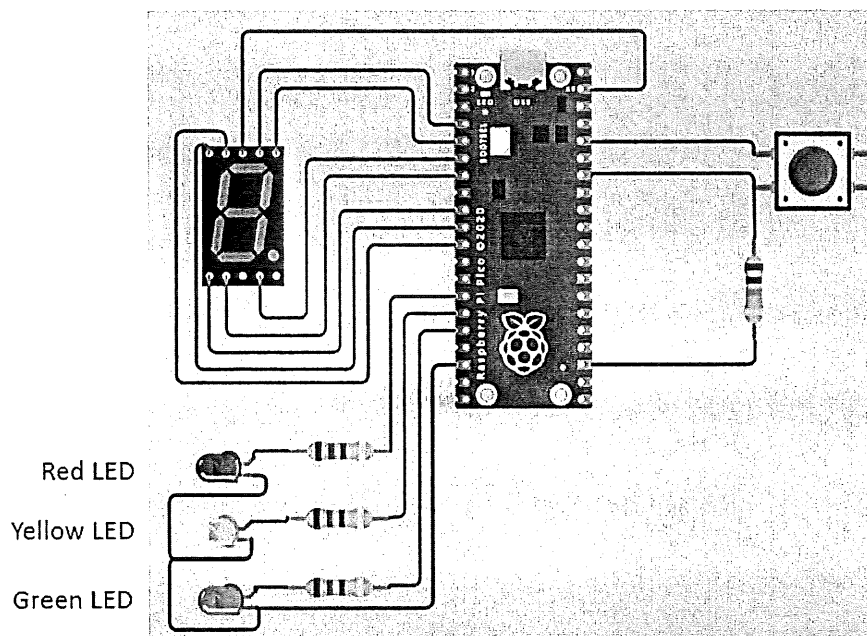


Figure 1

(25 marks)

QUESTION 2

Figure 2 shows the hardware layout of a machine front panel. It is equipped with an LCD and three buttons.

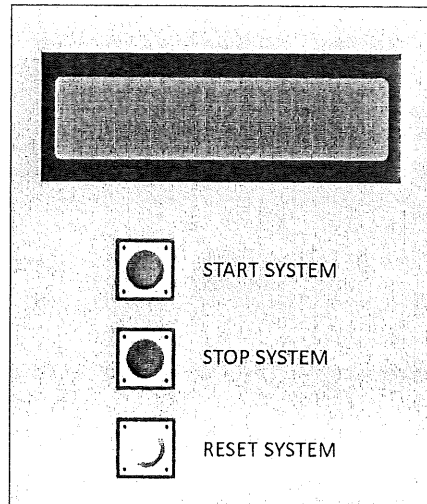


Figure 2

- a) Illustrate the wiring diagram of all the components to a Pico board on **Attachment A**. (6 marks)
- b) Produce a program for the front panel to perform the following operation:
- When Pico turns on, display a greeting message of "Machine Ready" and "Press StartPB" on LCD.
 - If user press button Start, display a message of "Machine Status:" and "Operating" on LCD.
 - If user press button Reset, display a message of "Machine Status:" and "System Reset" on LCD.
 - If user press button Stop, display a message of "Machine Status:" and "Process Stopped" on LCD. Make the displaying message blink two times here.

(25 marks)

QUESTION 3

Home electrical devices are being controlled using a keypad. The electrical devices are turn on and off based on the following keypad input values:

- If keypad 1 is pressed, fan will turn on and if keypad 3 is pressed, fan will turn off.
- If keypad 4 is pressed, hall lamp will turn on and if keypad 6 is pressed, hall lamp will turn off.
- If keypad 7 is pressed, aircond will turn on and if keypad 9 is pressed, aircond will turn off.
- If keypad A is pressed, all electrical devices will turn on. And if keypad C is pressed, all electrical devices will turn off.

Based on this application:

- a) Illustrate the wiring diagram of all the components to a Pico board on **Attachment B**. Represent each electrical device with LED in the wiring diagram. (6 marks)

- b) Produce a program to run this system.

(20 marks)

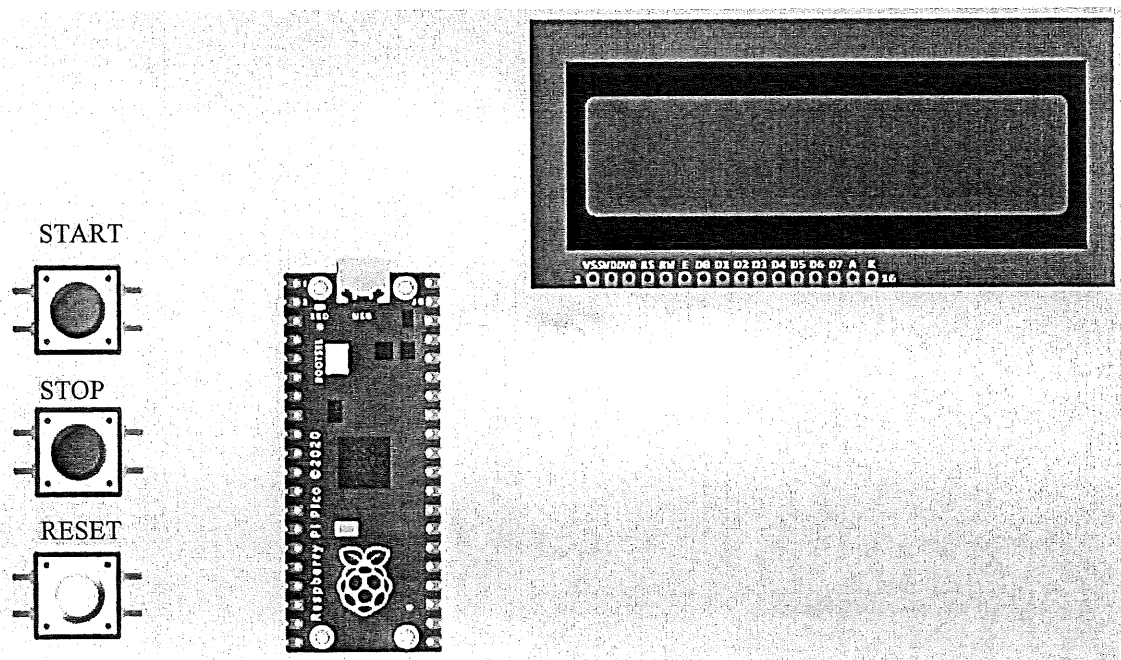
QUESTION 4

- a) The Pico board has a built in ADC. State the quantity of ADC pins and its pin location. (4 marks)
- b) The ADC in Pico is known to be in 12-bits resolution. Describe the reason why it gives out a number ranging from 0 – 65,535 and not 0 – 4095. (4 marks)
- c) Produce a program to monitor the changes of voltage value from 0V to 3.3V by using a potentiometer. Display the voltage value at the shell area and turn on the following LEDs according to the condition below:
- Green LED on when voltage is over 2.0V
 - Red LED on when voltage is less than 2.0V

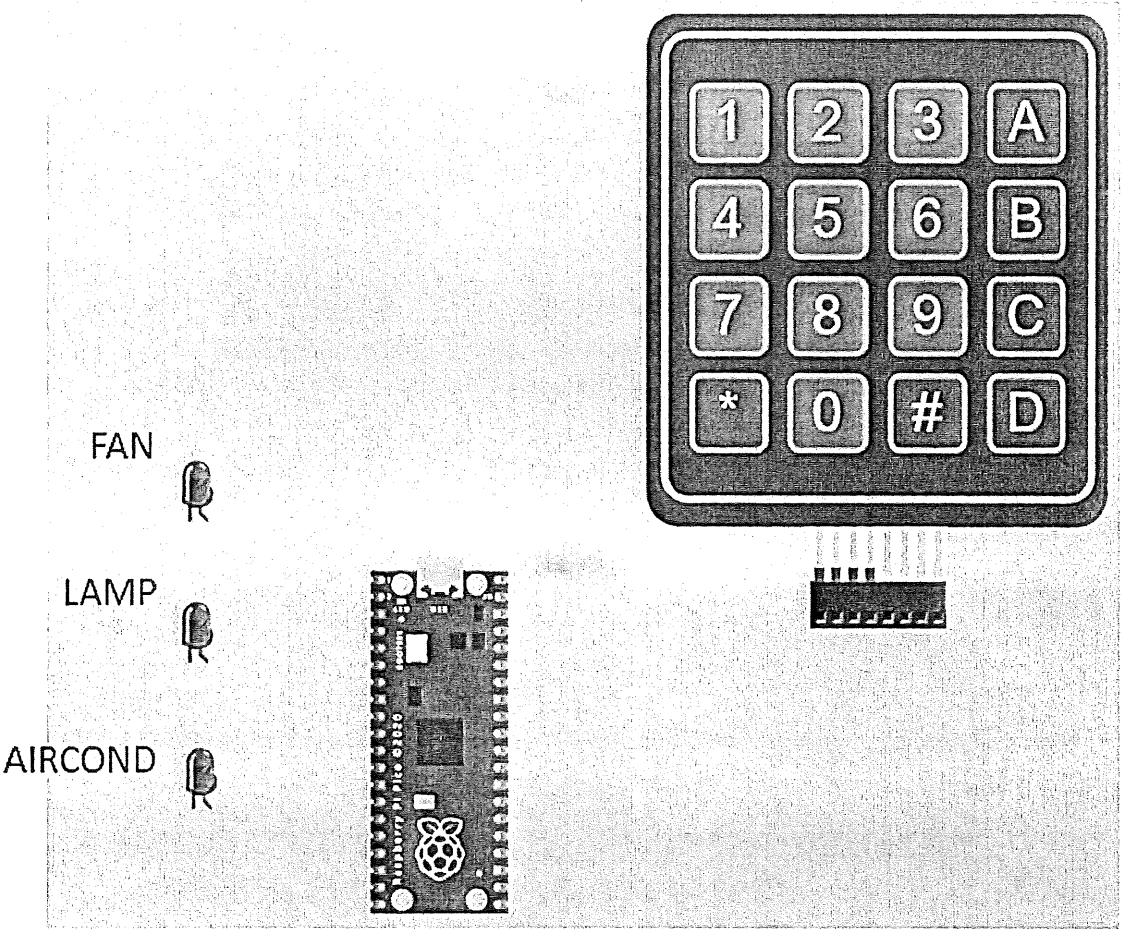
(10 marks)

-----End of Question-----

ATTACHMENT A

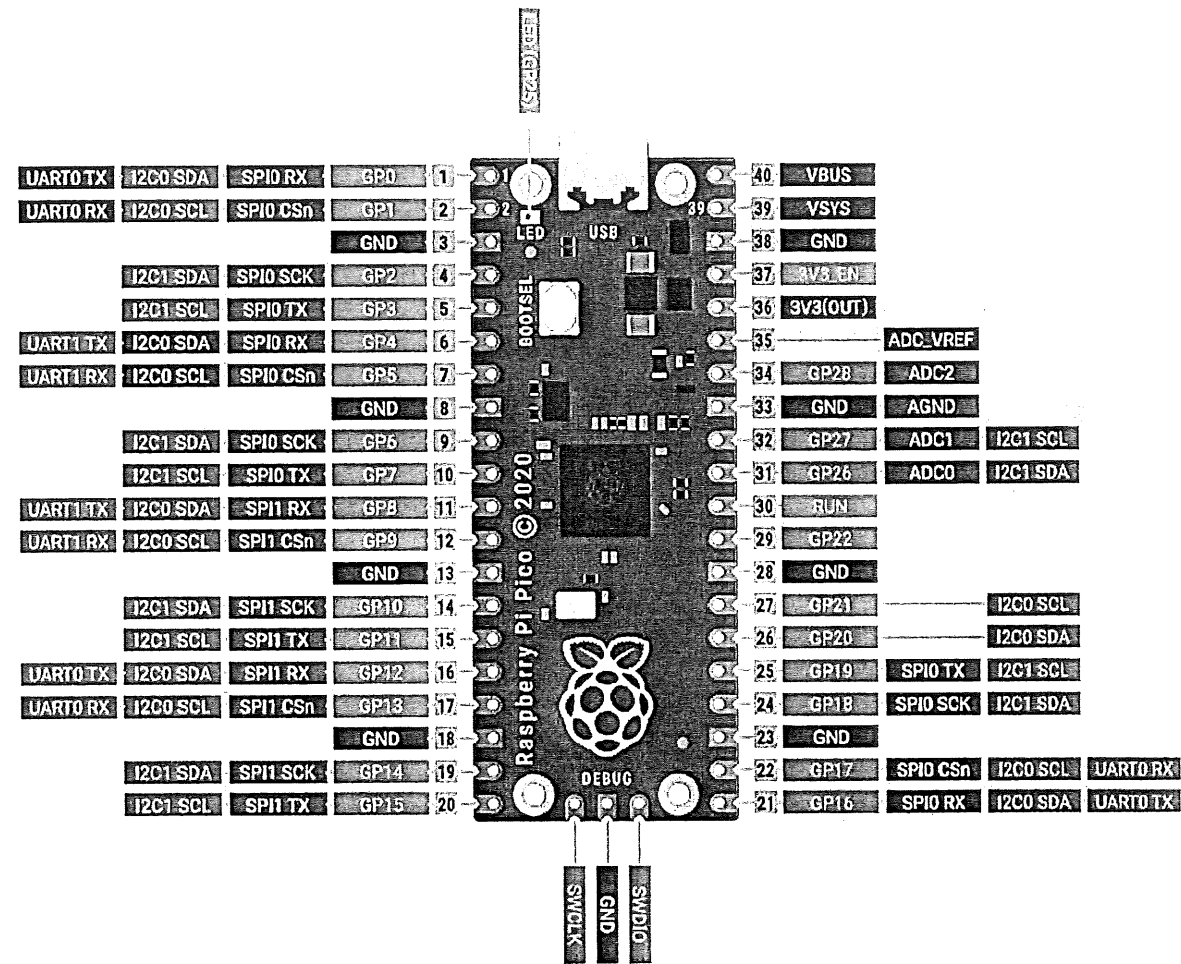


ATTACHMENT B



APPENDIX 1

PICO PINOUT DIAGRAM



APPENDIX 2

i2c LCD code

```
from machine import Pin, I2C
from utime import sleep
from lcd_api import LcdApi
from pico_i2c_lcd import I2cLcd
```

```
I2C_ADDR      = ?
I2C_NUM_ROWS  = ?
I2C_NUM_COLS  = ?
```

```
i2c = I2C(0, sda=machine.Pin(?), scl=machine.Pin(?), freq=400000)
lcd = I2cLcd(i2c, I2C_ADDR, I2C_NUM_ROWS, I2C_NUM_COLS)
```

LCD Code

```
from machine import Pin
from utime import sleep
from gpio_lcd import GpioLcd
```

```
lcd = GpioLcd(rs_pin=Pin(?),
              enable_pin=Pin(?),
              d4_pin=Pin(?),
              d5_pin=Pin(?),
              d6_pin=Pin(?),
              d7_pin=Pin(?),
              num_lines=?, num_columns=?)
```

Keypad code:

```
# Connect Keypad pins as below
col_list=[?,?,?,?]
row_list=[?,?,?,?]

#Set rows pin as output
for x in range(0,4):
    row_list[x]=Pin(row_list[x], Pin.OUT)
    row_list[x].value(1)

#Set column as input
for x in range(0,4):
    col_list[x] = Pin(col_list[x], Pin.IN, Pin.PULL_UP)

# Create a map between keypad buttons and chars
key_map=[["?", "?", "?", "?"],\
          ["?", "?", "?", "?"],\
          ["?", "?", "?", "?"],\
          ["?", "?", "?", "?"]]

def Keypad4x4Read(cols,rows):
    for r in rows:
        r.value(0)
        result=[cols[0].value(),cols[1].value(),cols[2].value(),cols[3].value()]
        if min(result)==0:
            key=key_map[int(rows.index(r))][int(result.index(0))]
            r.value(1) #manages key kept pressed
            return(key)
    r.value(1)
```