



**FINAL
ALTERNATIVE ASSESSMENT**

(COVER PAGE)

Session : August 2021

Programme : Diploma in Electrical & Electronic Engineering (DEEI)

Course : EEE2114: Introduction to Embedded System

Date of Examination : 4 December 2021 (Saturday)

Time : 2.00pm – 5.00pm Reading Time : Nil

Duration : 3 Hours

Special Instructions :

This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions. All questions carry equal marks.

Material permitted : Nil

Materials provided : Nil

Examiner(s) : Dr Su Hsiao Wei

Chief Moderator : Steven Khoo Boo Tap

This paper consists of 7 printed pages, including the cover page

INTI INTERNATIONAL COLLEGE PENANG

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING PROGRAMME (DEEI)
 EEE2114: INTRODUCTION TO EMBEDDED SYSTEMS
 FINAL ALTERNATIVE ASSESSMENT: AUGUST 2021 SESSION

Instructions: This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions. All questions carry equal marks.

Question 1

- a) “An embedded system can be a very small piece of electronic circuitry that performs a specific function within a larger system”. Describe how a digital smartwatch can be an example of embedded systems applications using the diagram shown in Figure 1(a).

(5 marks)

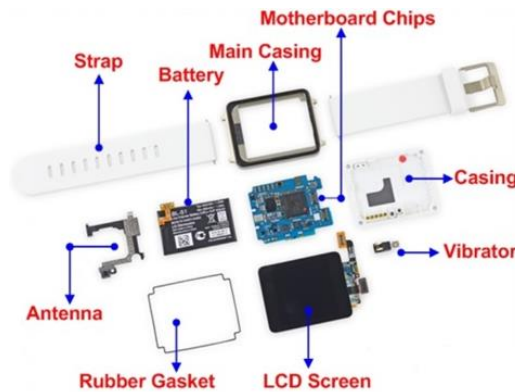


Figure 1(a) Internal structure of digital smartwatch.

- b) Provide the differences between PIC16F887 and PIC16F877A microcontrollers by completing Table 1(b) as shown below. Copy Table 1(b) into your answer sheet.

Table 1(b) PIC16F887 and PIC16F877A differences.

Description	PIC16F887	PIC16F877A
Internal Oscillator (Hz)		
Number of Analog Pins		
Total I/O pins		
Ports (Number of Bits) E.g. Port A(2)		
ADC (n-bit, n-channel)		

(10 marks)

- c) Provide five differences between CISC and RISC CPU architectures by completing Table 1(c) as shown below. Copy Table 1(c) into your answer sheet.

Table 1(c) CISC and RISC differences.

CISC	RISC

(5 marks)

- d) Illustrate why PIC16F877A microcontroller is based on Harvard architecture and not Von Neumann architecture. Show your answer with the aid of appropriate diagram.

(5 marks)

Question 2

- a) Describe the following embedded systems types as shown in Figure 2(a) by giving examples for each embedded system.

- i) Stand Alone embedded systems.

(2.5 marks)

- ii) Mobile embedded systems.

(2.5 marks)

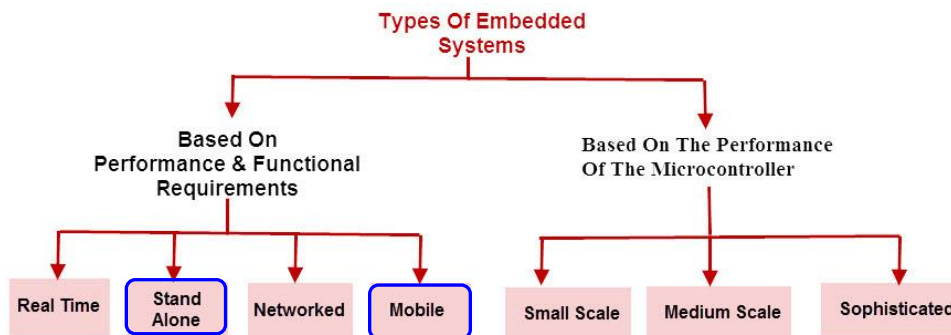


Figure 2(a) Types of Embedded System.

- b) Identify and describe the function of the following blocks labelled in Figure 2(b).

- i) Label (A)

(3 marks)

- ii) Label (B)

(3 marks)

- iii) Label (C) (3 marks)
- iv) Label (D) (3 marks)
- v) Label (E) (3 marks)

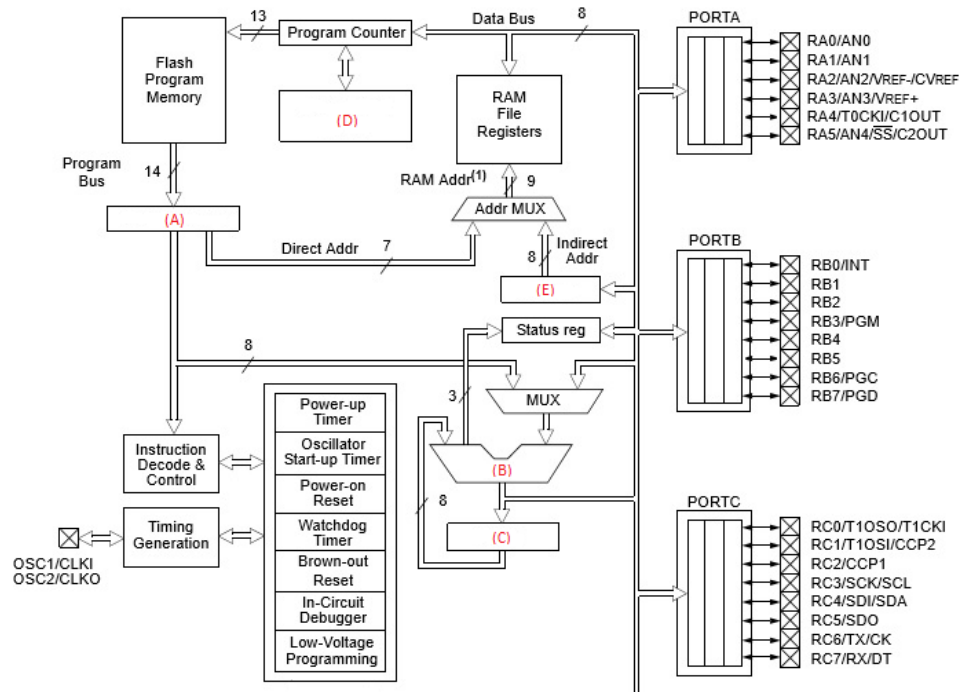
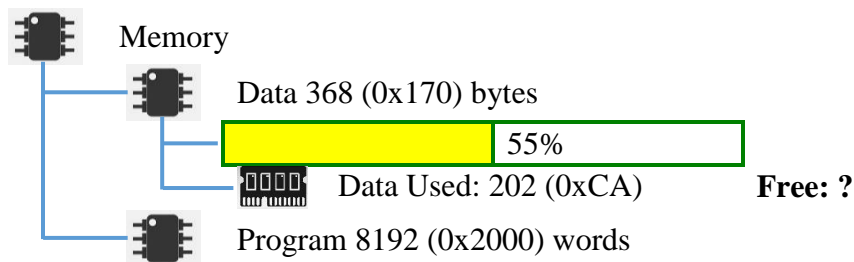
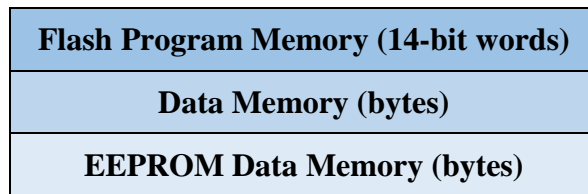
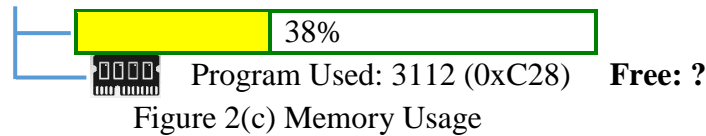


Figure 2(b) A microcontroller internal architecture.

- c) Calculate the amount of memory usage left in Data memory and Program memory of Figure 2(c). (5 marks)





Question 3

- a) A Timer 2 is used to generate a delay of 128µs, as shown in block diagram in Figure 3(a).
 - i) Calculate the value of the PR2 if the TMR2 is 0, the prescaler and postscaler of 1:4 are selected. Assume that the crystal clock is running at the frequency of 8MHz. Ignore the overhead due to instructions in the calculation. (5 marks)
 - ii) Justify how the microcontroller knows the delay of 128µs has reached. (3 marks)

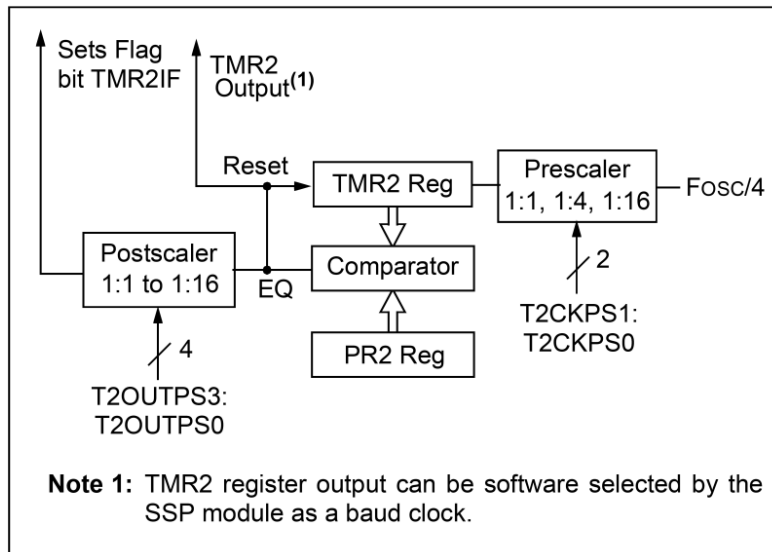


Figure 3(a) Timer 2 configuration for a delay of 128µs.

- b) The INTCON Register of a PIC16F628A microcontroller is set as shown in Table 3(b-1).

Table 3(b-1) Initial INTCON register.

INTCON Register	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
	1	0	0	0	1	0	0	0

- i) Determine which interrupt bits are enabled. (3 marks)
- ii) An interrupt occurs and the INTCON register is found to have changed to the setting shown in Table 3(b-2). Determine which interrupt source has been called. (3 marks)

Table 3(b-2) After interrupt occurred.

INTCON	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Register	1	0	0	0	1	0	0	1

- c) A single microcontroller can serve several devices. There are TWO (2) methods, which can be used by microcontroller to serve the devices: Polling and Interrupt. Present the advantage and disadvantage of each method as shown in Table 3(c). Copy Table 3(c) into your answer sheet.

Table 3(c) Comparison between Polling and Interrupt.

	Advantage	Disadvantage
Polling		
Interrupt		

(4 marks)

- d) Using C programming language in MPLAB X IDE, write a programme to show how to make the LED blinks ON and OFF alternatively for 2s. The LED Blinking sequence will only start after receiving an input from tact switch. PORTB and PORTD should be used as output (LED) and input (switch), respectively. A 4MHz crystal oscillator should be used. Include the header file(s) and comments in your code. Assuming config.h header file is available to be used for setting the configuration bits.

(7 marks)

Question 4

- a) Compare the advantages and disadvantages of asynchronous and synchronous data transmission by completing Table 4(a) as shown below. Copy Table 4(a) into your answer sheet.

Table 4(a) Comparison between synchronous and synchronous transmissions.

	Advantages	Disadvantages
Asynchronous transmission		
Synchronous transmission		

(8 marks)

- b) The TXTSA Register and RCSTA Register of a PIC16F877A microcontroller is set as shown in Table 4(b-1) and Table 4(b-2) respectively. Table 4(b-3) indicates the setting required for configuring the 9600 baud rate for 8 MHz oscillator at low speed operating in asynchronous mode using 8-bit data. Assume that there is no error and awaiting for the data being to be transmitted. Table 4(b-4) shows the Baud Rate Formula for this specific microcontroller.

Table 4(b-1) TXTSA register.

TXTSA	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Register	0	0	1	0	0	0	0	0

Table 4(b-2) RCSTA register.

RCSTA	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Register	1	0	0	0	0	0	0	0

Table 4(b-3) SPBRG register.

SPBRG	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Register	?	?	?	?	?	?	?	?

Table 4(b-4) Baud rate formula.

SYNC	BRGH = 0 (Low Speed)	BRGH = 1 (High Speed)
0	(Asynchronous) Baud Rate = $F_{osc}/(64(X + 1))$	Baud Rate = $F_{osc}/(16(X + 1))$
1	(Synchronous) Baud Rate = $F_{osc}/(4(X + 1))$	N/A

Legend: X = value in SPBRG (0 to 255)

- i) Describe in details the setting used for TXSTA register. (3 marks)
- ii) Describe in details the setting used for RCSTA register. (4 marks)
- iii) Determine the setting used for SPBRG register. Show the calculation working clearly. (4 marks)
- c) Compare between SPI mode and I2C mode as shown in Table 4(c). Copy Table 4(c) into your answer sheet.

Table 4(c): Table of comparison.

Description	SPI	I2C
Data Rate		
Number of Masters		
Number of pins needed for data transfer		

(6 marks)

~THE END~