

NANYANG TECHNOLOGICAL UNIVERSITY**SEMESTER 1 EXAMINATION 2021-2022****MA4832 – MICROPROCESSOR SYSTEMS**

November/December 2021

Time Allowed: 2½ hours

INSTRUCTIONS

1. This paper contains **SECTION A & SECTION B** and comprises **FOUR (4)** pages.
 2. **COMPULSORY** to answer **ALL** questions in both sections.
 3. All questions carry equal marks.
 4. This is an **OPEN BOOK** examination.
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SECTION A

1. ARM Cortex-M4 is a 32-bit microcontroller, which has memory for data storage and data communication. Please give solutions to the following questions:
 - (a) What is the single-precision floating point representation of the real value -78.1234? (5 marks)
 - (b) What is the value of B after the executing of the following code?

```

A      DCD 25      ; decimal
B      DCD 80      ; decimal
MOV   A, B LSR #2 ;
MOV   B, A LSL #9 ;

```

(5 marks)

- (c) An external device waits for receiving data from port C. What will be the output data transmitted by port C after the execution of the following code?

```

PORTC    EQU 0x4000.630C
MOV      r0, PORTC  ;
MOV      r1, #0x0F   ; hexadecimal number
STR      r1, [r0]    ;

```

(5 marks)

Note: Question 1 continues on page 2.

- (d) An external device sends 0xFF to port D. What will be the input data received by port D after the execution of the following code

```

PORTD      EQU 0x4000.70F0
MOV        r0, PORTD ;
LDR        r1, [r0] ;

```

(5 marks)

- (e) If the decimal number 0.3697 is represented by a hexadecimal number with four digits after the decimal point, what is the result?

(5 marks)

2. ARM Cortex-M4 is a 32-bit microcontroller, which could undertake both logical and arithmetic operations. Please give solutions to the following questions:

- (a) What should be the value of X so that the value of R1 will become 0xBBDD after the execution of the following code?

```

MOV        R1, #0xABCD
MOVW      R2, X
ORR        R1, R1, R2

```

(5 marks)

- (b) What should be the value of X so that the value of R0 is equal to 500 after the execution of the following code?

```

MOV        R1, #12
MOV        R2, #56
MOV        R3, X
MLA        R0, R1, R3, R2

```

(5 marks)

- (c) What should be the value of Y so that the value of R1 is equal to 0xBC7D after the execution of the following code?

```

MOV        R1, #0xFFFF
MOVW      R2, Y
MVN        R2, R2
AND        R1, R1, R2

```

(5 marks)

Note: Question 2 continues on page 3.

(d) What is the value of R0 after the execution of the following code?

MOV	R1, #5
MOV	R2, #15
CMP	R1, R2, LSR #2
ANDGT	R0, R1, R2
SUBLT	R0, R2, R1

(5 marks)

(e) What is the value of R0 after the execution of the following code?

MOVW	R1, #A5A5
MOVW	R2, #FFFF
EOR	R0, R1, R2

(5 marks)

SECTION B

- 3 (a) (i) Calculate the Hexadecimal number conversion for a 3.15Vdc analogue voltage signal after converting it through a 0 – 5Vdc 8 bit ADC. (3 marks)
- (ii) Determine the analogue voltage difference between this Hex number conversion to an 8 bit DAC when compare to the original 3.15Vdc signal. (3 marks)
- (b) (i) Describe the working principle of the ULN2003 Stepper motor driver when driving a stepper motor. (6 marks)
- (ii) Describe how the TM4C123G is connected to the ULN2003 stepper motor driver in order to drive stepper motor. How is the TM4C123G configured in order to be connected to the stepper motor driver? Why is the running of stepper motor considered inefficient? (6 marks)
- (c) (i) The PWM Generator 0 is to be initialised with a 20-kHz frequency. The system clock is 40 MHz. Determine the load value to be written to the PWM0LOAD register. (3 Marks)
- (ii) What is the purpose of the dead band generator that is enabled in the PWMn Dead Band Control Register of the TM4C123G when generating a PWM signal? (4 marks)

- 4 (a) (i) The UART function in the TM4C123G is to be initialised with the following information;

PB0 as U1Rx
PB1 as U1Tx

Bus Clock 40Mhz
Baud Rate 115200kbit/s

Determine the address of the following registers and the data that has to be written to setup the UART configuration. Use APB.

Register	Address (Hex)	Data (Hex)
RCGCUART		
RCGCGPIO		
GPIOPCTL		
GPIOAFSEL		
UARTIBRD		
UARTFBRD		

(12 Marks)

- (ii) Show your calculations for the values for **UARTIBRD** and **UARTFBRD**.

(4 marks)

- (b) The interrupt for UART1 is to be enabled with priority set to 1. What are the register names, the address and data that are needed to setup this function?
(4 marks)
- (c) In SSI communications, if the SSI Status Register (SSISR) shows a value of 0x18, determine the status of the SSI and explain what it means.
(5 marks)

END OF PAPER

MA4832 MICROPROCESSOR SYSTEMS

Please read the following instructions carefully:

- 1. Please do not turn over the question paper until you are told to do so. Disciplinary action may be taken against you if you do so.**
2. You are not allowed to leave the examination hall unless accompanied by an invigilator. You may raise your hand if you need to communicate with the invigilator.
3. Please write your Matriculation Number on the front of the answer book.
4. Please indicate clearly in the answer book (at the appropriate place) if you are continuing the answer to a question elsewhere in the book.