Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 1

Winter Semester: 2021 - 22
Course Code: ECE 308
Course Name: Embedded System Design Using ARM
Program & Sem: B. Tech., 6th Semester

Date: 26/04/2022
Time: 01:30 pm to 02:30 pm
Max Marks: 30
Weightage: 15 %

Instructions:
(i) Read the all questions carefully and answer accordingly.
(ii) Use of scientific (non – programmable) calculators is permitted

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TWO marks. (3Qx 2M= 6M)

1. Embedded system is unlike the general-purpose computer, which is engineered to manage a wide range of processing tasks. Define an embedded system and give two examples of embedded systems (C.O.No.1) [Knowledge]

2. ARM general purpose registers hold 32 bit data or address. Describe the purpose of link register and program counter. (C.O.No.1) [Knowledge]

3. MVN is a special type of move instruction. What would be the content of R6 after the following instruction is executed.

MVN R6, #0XA2 (C.O.No.2) [Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each question carries SIX marks. (2Qx6M=12M)

4. Mr. Suraj has written the following code segment.

```
LDR R1, =0X400785F2
MOV R2, #0XE8
LSLS R1, #2
BICCSS R2, R2, R1
SUBS R3, R2, R1
```

Analyze the code and estimate the content of the registers and the status of flags as each instruction is executed.

(C.O.No.2) [Comprehension]

5. Mr. Vivek wrote a code segment as below

```
ADD R1, R1, R1
ADD R1, R1, R1
ADD R3, R1, R2
```

His friend Mr. Praise said that this three instructions can be replaced by a single instruction. Analyze the code segment given and predict what it does. Then help Mr. Vivek and write a single instruction which will do the same function as the three instruction combined does.

Part C [Problem Solving Questions]

Answer the Question. The question carries TWELVE marks. (1Qx12M=12M)

6. Suppose you are a design engineer at ARM®. Two pass codes are coming through the system. Each pass code is 8 bits long. The format of the pass code is 0X000000PQ and 0X000000RS. Here P, Q, R, and S are nibbles. They are by default available in registers R6 and R7. Your job is to give the system a new pass code which is generated by using the following arithmetic operation.

$$2.P + Q - 5.R + 7.S$$

After this, if the result is negative 4 is added to the result. If the result is not negative, the passcode is as it was obtained during the previous step. You have to generate the new passcode and store it in register R0. Write a program in Assembly Language to perform the same. Analyze your code and generate the new passcode if register R6 and R7 are having 0X00000064 and 0X000000E8 respectively.

(C.O.No. 2) [Application]

Suffix	*Description*	*Flags tested*
EQ	Equal	Z=1
NE	Not equal	Z=0
CS/HS	Unsigned higher or same	C=1
CC/LO	Unsigned lower	C=0
MI	Minus	N=1
PL	Positive or Zero	N=0
VS	Overflow	V=1
VC	No overflow	V=0
HI	Unsigned higher	C=1 & Z=0
LS	Unsigned lower or same	C=0 or Z=1
GE	Greater or equal	N=V
LT	Less than	N!=V
GT	Greater than	Z=0 & N=V
LE	Less than or equal	Z=1 or N=!V
AL	Always	

Figure: Data for reference

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PRESIDENCY UNIVERSITY
BENGALURU
SCHOOL OF ENGINEERING

TEST – 2

Winter Semester: 2021 - 22
Course Code: ECE 308
Course Name: Embedded System Design Using ARM
Program & Sem: B. Tech., VI Semester

Date: 1st June 2022
Time: 01:30 PM to 02:30 PM
Max Marks: 30
Weightage: 15 %

Instructions:

(i) Read the all questions carefully and answer accordingly.

(ii) Use of scientific (non – programmable) calculators is permitted

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TWO marks. (3Qx 2M= 6M)

Q.NO 1. LPC2148 is an ARM7 microcontroller. It is a ____ bit microcontroller. It has ____ pins, ____ RAM and ____ ROM (C.O.No.3) [Knowledge]

Q.NO 2. Zero extension and sign extension can be easily done in ARM. What would be the content of R2 after the following set of instructions is executed? (C.O.No.2) [Knowledge]

```
        LDR R0, =DATA
        LDRSB R2, [R0]
DATA    DCD 0X092
```

Q.NO 3. The comparison instructions are used to compare or test a register with a 32 – bit value. Discuss the CMP instruction and mention how the flags are affected. (C.O.No.2) [Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each question carries SEVEN marks. (2Qx7M=14M)

Q.NO 4. Suppose you are a design engineer in ARM® . You are required to generate a square wave form which has a period of 15 ms. The duty cycle required is 20%. Draw the waveform. Write a C code using TIMER1 to generate the square waveform.

[7 Marks] (C.O.No. 3) [Application]

Q.NO 5. Mr. Suraj has written the following code segment.

```
                AREA TEST2, CODE, READONLY
                LDR R1, =0X40000000
                LDR R0, = MYDATA
                LDR R3, [R0, #4]!
                LDR   R2, [R0, #4]!
                UMLAL R4, R5, R2, R3
                STRH R4,[R1],#2
                STRH R5,[R1], #2
STOP                  B STOP
MYDATA          DCD 0X81000002, 0X91000002, 0X0000002
                END
```

Analyze the code and estimate the content of the registers as each instruction is executed.

[7 Marks] (C.O.No.2) [Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The question carries TEN marks. **(1Qx10M=10M)**

Q.NO 6. The annual rainfall in millimeters in Bangalore for the past 10 years are stored in RAM location starting from 0X40000000 onwards. Write an Assembly Language Program to compute the average annual rain fall and store the result in memory location 0X50000000. The rainfall values are stored as 8 bit numbers. (C.O.No. 2) [Application]

Suffix	*Description*	*Flags tested*
EQ	Equal	Z=1
NE	Not equal	Z=0
CS/HS	Unsigned higher or same	C=1
CC/LO	Unsigned lower	C=0
MI	Minus	N=1
PL	Positive or Zero	N=0
VS	Overflow	V=1
VC	No overflow	V=0
HI	Unsigned higher	C=1 & Z=0
LS	Unsigned lower or same	C=0 or Z=1
GE	Greater or equal	N=V
LT	Less than	N!=V
GT	Greater than	Z=0 & N=V
LE	Less than or equal	Z=1 or N=!V
AL	Always	

Figure: Data for reference

Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM EXAMINATION

Winter Semester: 2021 - 22
Course Code: ECE 308
Course Name: Embedded System Design Using ARM
Program & Sem: B. Tech. VIth Semester

Date: 30TH June 2022
Time: 09:30AM to 12:30PM
Max Marks: 100
Weightage: 50%

Instructions:

(i) Read the all questions carefully and answer accordingly.

(ii) Scientific Calculators are permitted

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TWO marks (10Q x 2M = 20M)

Q.NO 1. ARM follows Reduced Instruction Set Computer philosophy. Identify four differences between RISC and CISC processors. (C.O.No.1) [Knowledge]

Q.NO 2. RISC design philosophy is implemented with four major design rules. List the four major design rules. (C.O.No.2) [Knowledge]

Q.NO 3. The processor mode determines which register are active and the access rights to the cpsr register itself. Outline the processor modes and mention which is the privileged mode and unprivileged mode. (C.O.No.1) [Knowledge]

Q.NO 4. What will the below instruction perform?
RSB R4, R5, #0 (C.O.No.2) [Knowledge]

Q.NO 5.LPC2148 is a 32 bit ARM -7 microcontroller. It has _____ number of _____ bit ADC of _____ Type. It has ___ timers (C.O.No.3) [Knowledge]

Q.NO 6. List any one arithmetic instruction using any condition you want and mention in one sentence what that instruction does. (C.O.No.3) [Knowledge]

Q.NO 7. Zero extension and sign extension can be easily done in ARM. Using an example, show how sign extension can be done in assembly language programming
(C.O.No.3) [Knowledge]

Q.NO 8. Calculate the effective address when the following instruction is executed.
LDR R4, [R2, R3, LSL #3]
(C.O.No.2) [Knowledge]

Q.NO 9. List the logical instructions available in ARM7 Assembly Language Programming
(C.O.No.2) [Knowledge]

Q.NO 10. What does the following line written in C does?
$IO0DIR \mid = (1 \ll 4)$
(C.O.No.4) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries EIGHT marks. (4Q x 8M = 32M)

Q NO: 11. Timers are used to generate the required delay. A certain application requires a square wave of duty cycle 90% and a frequency of 500 Hz. Use TIMER0 to generate the required waveform and a CPU clock of 30 MHz. (C.O.No.3) [Comprehension]

QNO: 12. Any arithmetic expression can be implemented in assembly language programming of ARM. Write a simple Assembly language program to evaluate the following expression.

$$3.X + 7.Y$$

Here X and Y are 10 and 17 respectively and are stored in the location 0X40000000 and 0X40000001 respectively. Store the result in memory location 0X40000010.

(C.O.No.2) [Comprehension]

QNO:13 Analyze the code segment given below and find out what each instruction does and find the content of the registers.

```
                AREA TEST2, CODE, READONLY
                LDR R1, =0X40000000
                LDR R0, = MYDATA
                LDR R3, [R0], #4
                LDR R2, [R0, #4]!
                ADD R4, R2, R3
                SUBS R5, R4, #0X56
                STRB R5,[R1],#2
STOP                B STOP
MYDATA          DCD 0X00000025, 0X000000FD, 0X000000AB
                END
```

(C.O.No.2) [Comprehension]

QNO:14 Write an Assembly Language program to check whether the 8 bit number stored in RAM location 0X40000000 is even or odd. If the number is ODD, store OO in location 0X40000001 and if the number is EVEN, store EE in location 0X40000001

(C.O.No.2) [Comprehension]

Part C [Problem Solving Questions]

Answer ANY 4 Questions. Each question carries TWELVE marks. (4Q x 12M = 48M)

Q NO:15. Speed of DC motors are usually controlled using PWM. It is required to control the speed of the dc motor such that speeds are 20%, 60% and 80% of the full speed. Frequency required is 1000 Hz. Apply your knowledge of PWM to write a code in C to achieve this. You may use PWM1, PWM2, and PWM3 channels and a CPU clock of 50 MHz. (C.O.No. 3) [Application]

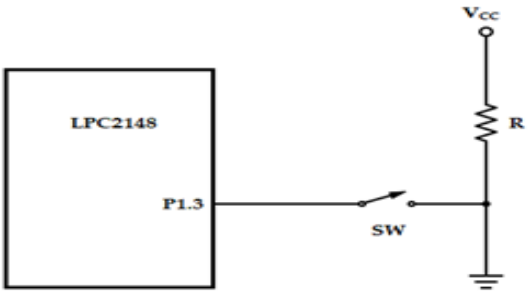
Q NO:16. LPC2148 can be interfaced with a variety of displays. One such display device is the seven segment display. Using two Common Cathode 7 segment displays, write a C code to display the following

(C.O.No. 4) [Application]

Q NO:17. (a) Any programmer is interested in the program flow model of ARM. Illustrate the program flow model of ARM in detail with a suitable sketch.

(b) The fundamental idea in computer architecture for increasing the speed is pipelining. Demonstrate in detail about pipelining process in ARM7. Briefly mention the stages in a five stage pipeline process. (C.O.No. 1) [Application]

Q NO: 18. Mr. Vivek was asked by this professor Dr. Pritam to interface a Single Pole Single Throw switch with LPC2148. He presented the block diagram shown right side.



Identify the mistakes if any, that Mr. Vivek has done in this arrangement. Produce the correct diagram of the interfacing and light an LED to identify whether the switch is pressed. If the switch is pressed, the LED should glow. Write the C code for the same. (C.O.No. 4) [Application]

Q. NO: 19 The year wise population of a small village is saved in 8 bit format from location 0X40000001 onwards. The location 0X40000000 contains the number of years. The Thahasildar wants the minimum population and the maximum population and he wants you to find the average of these two values. Employ Assembly Language Programming to write an effective code and store the minimum value in location 0X40000020, maximum value in location 0X40000021, and the average of these two values in locations 0X40000022(Quotient) and X40000023(Remainder)

(C.O.No. 2) [Application]

Data for reference

Suffix	*Description*	*Flags tested*
EQ	Equal	Z=1
NE	Not equal	Z=0
CS/HS	Unsigned higher or same	C=1
CC/LO	Unsigned lower	C=0
MI	Minus	N=1
PL	Positive or Zero	N=0
VS	Overflow	V=1
VC	No overflow	V=0
HI	Unsigned higher	C=1 & Z=0
LS	Unsigned lower or same	C=0 or Z=1
GE	Greater or equal	N=V
LT	Less than	N!=V
GT	Greater than	Z=0 & N=V
LE	Less than or equal	Z=1 or N=!V
AL	Always	

PINSEL0	*Pin Name*	*Function when 00*	*Function when 01*	*Function when 10*	*Function when 11*	*Reset Value*
1:0	P0.0	GPIO Port 0.0	TXD (UART0)	PWM1	Reserved	00
3:2	P0.1	GPIO Port 0.1	RXD (UART0)	PWM3	EINT0	00
5:4	P0.2	GPIO Port 0.2	SCL0 (I^2C0)	Capture 0.0 (Timer 0)	Reserved	00
7:6	P0.3	GPIO Port 0.3	SDA0 (I^2C0)	Match 0.0 (Timer 0)	EINT1	00
9:8	P0.4	GPIO Port 0.4	SCK0 (SPI0)	Capture 0.1 (Timer 0)	AD0.6	00
11:10	P0.5	GPIO Port 0.5	MISO0 (SPI0)	Match 0.1 (Timer 0)	AD0.7	00
13:12	P0.6	GPIO Port 0.6	MOSI0 (SPI0)	Capture 0.2 (Timer 0)	AD1.0	00
15:14	P0.7	GPIO Port 0.7	SSEL0 (SPI0)	PWM2	EINT2	00
17:16	P0.8	GPIO Port 0.8	TXD (UART1)	PWM4	AD1.1	00
19:18	P0.9	GPIO Port 0.9	RXD (UART1)	PWM6	EINT3	00
21:20	P0.10	GPIO Port 0.10	RTS (UART1)	Capture 1.0 (Timer 1)	AD1.2	00
23:22	P0.11	GPIO Port 0.11	CTS (UART1)	Capture 1.1 (Timer 1)	SCL1 (I^2C1)	00
25:24	P0.12	GPIO Port 0.12	DSR (UART1)	Match 1.0 (Timer 1)	AD1.3	00
27:26	P0.13	GPIO Port 0.13	DTR (UART1)	Match 1.1 (Timer 1)	AD1.4	00
29:28	P0.14	GPIO Port 0.14	DCD (UART1)	EINT1	SDA1 (I^2C1)	00
31:30	P0.15	GPIO Port 0.15	RI (UART1)	EINT2	AD1.5	00

PWM Control Register (PWNPCR)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R	E6	E5	E4	E3	E2	E1	Reserved		S6	S5	S4	S3	S2	Reserved	

PWM Timer Control Register (PWMTCR)

7	6	5	4	3	2	1	0
Reserved				PE	R	CR	CE

PWM Latch Enable Register (PWMLER)

7	6	5	4	3	2	1	0
R	M6	M5	M4	M3	M2	M1	M0

PWM Match Control Register (PWMMCR)

Reserved [31 : 24]							
Reserved [23 : 21]			PWM MR6S	PWM MR6R	PWM MR6I	PWM MR5S	PWM MR5R
PWM MR5I	PWM MR4S	PWM MR4R	PWM MR4I	PWM MR3S	PWM MR3R	PWM MR3I	PWM MR2S
PWM MR2R	PWM MR2I	PWM MR1S	PWM MR1R	PWM MR1I	PWM MR0S	PWM MR0R	PWM MR0I