AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

Computer and Systems Engineering Department
Specialized Programs
Junior Electrical Engineering, Electronics and Communications Engineering
Junior Electrical Engineering, Computer and Systems Engineering

Midterm - Spring 2021 **Course Code: *CSE 211*** ***Time allowed: 1 Hr.***

Introduction to Embedded Systems

The Exam Consists of **40** Questions in **8** Pages. ***Maximum Marks: 40 Marks*** **1 / 8**

تعليمات هامة

حيازة التيلفون المحمول مفتوحا داخل لجنة الأمتحان يعتبر حالة غش تستوجب العقاب وإذا كان ضرورى الدخول بالمحمول فيوضع مغلق فى الحقائب.

لا يسمح بدخول سماعة الأذن أو البلوتوث.

لايسمح بدخول أي كتب أو ملازم أو أوراق داخل اللجنة والمخالفة تعتبر حالة غش.

For each of the following multiple choice questions, select ONLY the ONE correct answer. Mark your choice in the answer sheet.

1. How many general-purpose registers do the ARM Cortex-M processors have?

A) 10	B) 11	C) 13	D) 15

2. What is the purpose of register R15 in the ARM Cortex-M processors?

A) R15 is used to store the return address	B) R15 is used to point the next instruction to be fetched
C) R15 is a stack pointer	D) None of the previous

3. What is the purpose of register R14 in the ARM Cortex-M processors?

A) R14 is used to store the return address	B) R14 is used to point the next instruction to be fetched
C) R14 is a stack pointer	D) None of the previous

4. Which bus(s) is(are) connected to the Instructions Flash ROM?

A) ICode bus	B) DCode bus	C) System bus	D) Answers (A) and (B)

5. Which bus(s) is(are) connected to the Data RAM?

A) ICode bus	B) DCode bus	C) System bus	D) Answers (A) and (B)

6. What is the purpose of the N flag in the PSR of Cortex-M processors?

A) The N flag is set after performing an N arithmetic operation	B) The N flag is set if the result of the operation is less than zero
C) The N flag is set if result of the operation is zero	D) None of the previous

7. What is the purpose of the V flag in the PSR of Cortex-M processors?

A) The V flag is set after performing an N arithmetic operation	B) The V flag is set if the result of the operation is less than zero
C) The V flag is set if result of the operation is zero	D) None of the previous

8. What is the size of the Flash ROM in the TM4C123 Microcontroller?

A) 32 KB	B) 64 KB	C) 128 KB	D) 256 KB

9. Using word aligned, each location in memory is

A) 1 byte	B) 2 bytes	C) 4 bytes	D) 8 bytes

PROG1: Q10-Q12	
1	#include <stdio.h>
2	int main(){
3	int x=0;
4	int i=0;
5	while (x<10){
6	x|=1<<i++;
7	printf("%d-",i);
8	}
9	return 0;
10	}

10. In PROG1, what is the printed output?

A) 1-2-3-4-5-6-7-8-9-	B) 0-1-2-3-4-5-6-7-8-9	C) 1-2-3-4-	D) 0-1-2-3-

11. In PROG1, what is the final value of *x*?

A) 10	B) 15	C) 11	D) 9

12. In PROG1, what is the final value of *x*, if line 5 is changed to be "while (x<=10)"?

A) 10	B) 15	C) 11	D) 9

PROG2: Q13-Q15	
1	#include <stdio.h>
2	int main(){
3	int y=15;
4	int i=7;
5	while (y>=15){
6	printf("%d-",i);
7	y&=~(1<<i--);
8	}
9	return 0;
10	}

13. In PROG2, what is the printed output?

A) 7-6-5-	B) 7-6-5-4-	C) 1-2-3-4-5-6-7-	D) 7-6-5-4-3-

14. In PROG2, what is the final value of *y*?

A) 10	B) 15	C) 7	D) 8

15. In PROG2, what is the final value of *y*, if line 5 is changed to be "while (y==15)"?

A) 10	B) 15	C) 7	D) 8

PROG3: Q16-Q18	
	AREA READ_variables, DATA, READONLY
	A DCD 2
	B DCD 3
	C DCD 1
	AREA WRITE_variables, DATA, READWRITE
	X DCD 0
	AREA MYCODE, CODE, READONLY
1	LDR R0, [R4]
2	LDR R4, =A
3	LDR R4, =B
4	LDR R1, [R4]
5	LDR R4, =C
6	LDR R2, [R4]
7	ADD R3, R0, R1
8	LDR R4, =X
9	SUB R3, R3, R2
10	STR R3, [R4]
11	END

Note: Line order is not correct in the above program.

16. In PROG3, what is the correct order for the above program to calculate X=(A+B)-C?

A) 2-1-3-4-7-5-6-9-10-8-11	B) 2-1-3-4-7-5-6-9-8-10-11
C) 4-2-1-9-5-6-7-8-10	D) 3-2-4-1-7-5-6-9-8-10

17. In PROG3, what is the value of R0 at the end of the program based on the selected order in Q16?

A) 0	B) 1	C) 2	D) 3

18. In PROG3, what is the value of R1 at the end of the program based on the selected order in Q16?

A) 0	B) 1	C) 2	D) 3

PROG4: Q19-Q20
AREA WRITE_variables, DATA, READWRITE
z DCD 0
AREA MYCODE, CODE, READONLY
ADR r4, a
LDR r0, [r4]
LSL r0, r0, #2
ADR r4, b
LDR r1, [r4]
AND r1, r1, #15
ORR r1, r0, r1
LDR r4, =z
STR r1, [r4]
B END_LOC
a DCD 1
b DCD 18
END_LOC
NOP
END

19. In PROG4, what is the value of r0 at the end of the program?

A) 2	B) 3	C) 4	D) 6

20. In PROG4, what is the value of r1 at the end of the program?

A) 2	B) 3	C) 5	D) 6

PROG5 Q21-Q25

```
        AREA    READ_variables, DATA, READONLY
A       DCD     7
B       DCD     4
C       DCD     5
        AREA    WRITE_variables, DATA, READWRITE
Z       DCD     0
        AREA    MYCODE, CODE, READONLY
        LDR     r0, =A                  ; STEP 01
        LDR     r1, [r0]                ; STEP 02
        LDR     r0, =A                  ; STEP 03
        ADD     r0, #8                  ; STEP 04
        LDR     r2, [r0]                ; STEP 05
        SUB     r3, r2, r1              ; STEP 06
        CMP     r3, #0                  ; STEP 07
        BLE     LOC1                    ; STEP 08
        B       LOC2                    ; STEP 09
LOC1
        MOV     r5, #0xFFFFFFFF         ; STEP 10
        EOR     r3, r3, r5              ; STEP 11
        ADD     r3, r3, #1              ; STEP 12
LOC2
        LDR     r6, =Z                  ; STEP 13
        STR     r3, [r6]                ; STEP 14
        END
```

21. In PROG5, what is the value of r1 after STEP-02?

A) 1	B) 5	C) 6	D) 7

22. In PROG5, what is the value of r2 after STEP-05?

A) 1	B) 4	C) 5	D) 7

23. In PROG5, which variable (memory location) is not used in this program?

A) A	B) B	C) C	D) Z

24. In PROG5, what is the value of r3 after STEP-06?

A) 0xFFFFFFEF	B) 0xFFFFFFFF	C) 0xFFFFFFFD	D) 0xFFFFFFFE

25. In PROG5, what is the value of r3 after STEP-12?

A) 0	B) 1	C) 2	D) 3

PROG6 Q26-Q31

```
        AREA    WRITE_variables, DATA, READWRITE
a       space   4
b       space   4
s_size  equ     12
s_b     space   s_size                  ; Stack base address
        AREA    MYCODE, CODE, READONLY
        ldr     sp, =s_b                ; STEP 1
        add     sp, #s_size             ; STEP 2
        ldr     r0, =a                  ; STEP 3
        mov     r4, #3                  ; STEP 4
        str     r4, [r0]                ; STEP 5
        ldr     r1, =b                  ; STEP 6
        mov     r4, #5                  ; STEP 7
        str     r4, [r1]                ; STEP 8
        ldr     r2, [r0]                ; STEP 9
        ldr     r3, [r1]                ; STEP 10
        add     r2, #1                  ; STEP 11
        add     r3, #1                  ; STEP 12
        bl      func                    ; STEP 13
        b       stop                    ; STEP 14
func
        push    {r2-r3}                 ; STEP 15
        ldr     r2, [r0]                ; STEP 16
        ldr     r3, [r1]                ; STEP 17
        str     r2, [r1]                ; STEP 18
        str     r3, [r0]                ; STEP 19
        pop     {r2-r3}                 ; STEP 20
        bx      lr
stop
        END
```

26. In PROG6, what is the value of r2 at the end of the program?

A) 2	B) 3	C) 4	D) 5

27. In PROG6, what is the value of r3 at the end of the program?

A) 2	B) 4	C) 5	D) 6

28. In PROG6, what is the content of variable *a* in memory before calling function *func*?

A) 3	B) 4	C) 5	D) 6

29. In PROG6, what is the content of variable *a* in memory after calling function *func*?

A) 1	B) 3	C) 4	D) 5

30. In PROG6, function *func* is used to

A) Swap the contents of registers r2 and r3	B) Swap the contents of registers r0 and r1
C) Swap the contents of variables *a* and *b* in memory	D) None of the previous

31. In PROG6, what is the value of SP after STEP-18?

A) s_b-8	B) s_b+20	C) s_b+4	D) s_b+8

PROG7 Q32-Q35

```
        AREA    READ_variables, DATA, READONLY
A       DCD     5
        AREA    WRITE_variables, DATA, READWRITE
Z       DCD     0
        AREA    MYCODE, CODE, READONLY
        LDR     r0, =A              ; STEP 01
        LDR     r1, [r0]            ; STEP 02
        MOV     r2, #1              ; STEP 03
        CMP     r1, #0              ; STEP 04
        BLE     LOC2                ; STEP 05
LOC1
        MUL     r3, r2, r1          ; STEP 06
        MOV     r2, r3              ; STEP 07
        SUB     r1, r1, #1          ; STEP 08
        CMP     r1, #0              ; STEP 09
        BLE     LOC2                ; STEP 10
        B       LOC1
LOC2
        LDR     r4, =Z              ; STEP 11
        STR     r2, [r4]            ; STEP 12
        END
```

32. In PROG7, what is the value of r1 after the first execution of STEP-08?

A) 0	B) 4	C) 5	D) 24

33. In PROG7, what is the value of r3 after the second execution of STEP-06?

A) 0	B) 1	C) 4	D) 20

34. In PROG7, what is the value of r1 after the execution of STEP-11?

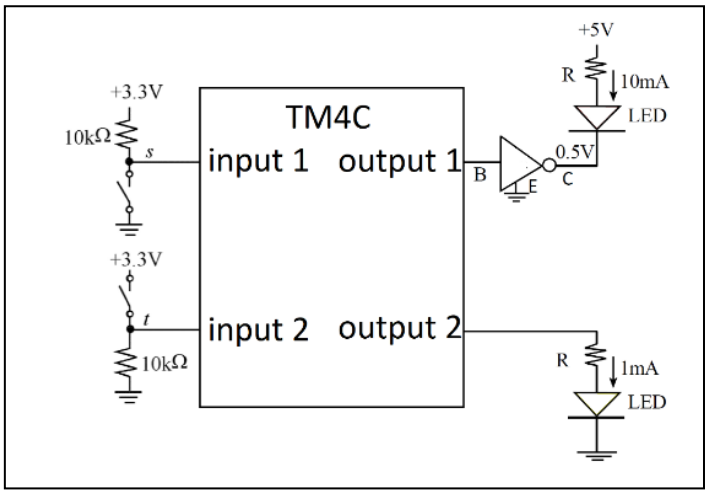
A) 0	B) 1	C) 4	D) 5

35. In PROG7, what is the value of r2 after the execution of STEP-12?

A) 100	B) 120	C) 130	D) 150

Figure 1 Q36-Q40: The figure below shows the schematic diagram for TM4C connected to two inputs and two outputs. PROG8 is executed on the shown TM4C. However, some statements are not correct. **Notes:**

- The state LOW/HIGH for input 1 can be read using variable u1.
- The state LOW/HIGH for input 2 can be read using variable u2.
- The state of the LED on output 1 (on/off) is set using output variable y1.
- The state of the LED on output 2 (on/off) is set using output variable y2.



PROG8 Q36-Q40	
1	#include <stdio.h>
2	#define V1 /* V1..V4 are to be set to 0 or 1 */
3	#define V2
4	#define V3
5	#define V4
6	
7	void read_u1(char *u1); /* used to read the input connected to input port 1 */
8	void read_u2(char *u2); /* used to read the input connected to input port 2 */
9	void set_y1(char *y1); /* used to set the output connected to output port 1 */
10	void set_y2(char *y2); /* used to set the output connected to output port 2 */
11	
12	int main(){
13	char u1, u2, y1, y2;
14	while (u1==u2) {
15	read_u1(u1); read_u2(u2);
16	If ((u1==V1) && (u2==V2)){
17	y1=V3;
18	y2=V4;
19	} else {
20	y1=~V3;
21	y2=~V4;
22	}
23	set_y1(y1); set_y2(y2);
24	}
25	printf("u1=%d, u2=%d",u1,u2);
26	return 0;
27	}

36. In PROG8, line 15 is not correct and it should be:

A) read_u1(*u1); read_u2(*u2);	B) read_u1(&u1); read_u2(&u2);
C) read_u1(u1); read_u2(u2);	D) read_u1(%u1); read_u2(%u2);

37. In PROG8, what values should we assign to V1 and V2, if we need the condition at line 16 to be true when both switches are pressed?

A) V1 to 0 and V2 to 0	B) V1 to 0 and V2 to 1	C) V1 to 1 and V2 to 0	D) V1 to 1 and V2 to 1

38. In PROG8, what values should we assign to V3 and V4, if we want to turn both LEDs ON when both switches are pressed?

A) V3 to 0 and V4 to 0	B) V3 to 0 and V4 to 1	C) V3 to 1 and V4 to 0	D) V3 to 1 and V4 to 1

39. In PROG8, the purpose of line 14 is to ensure that the states of both LEDs will be updated (set/reset) with every change in (event on) the two switches (all time). However, line 14 is not correct and it should be:

A) while (u1 || u2)	B) while (u1 && u2)	C) while (0)	D) while (1)

40. In PROG8, after fixing the program as in Q39, what message will be printed from line 25 if both switches are pressed?

A) u1=1, u2=1	B) u1=0, u2=1	C) u1=1, u2=0	D) None of the previous

END of Exam

Examination Committee ***Exam Date: 8th of May, 2021***

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