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 2022 **Course Code: *CSE 211*** ***Time allowed: 1 Hr.***

Introduction to Embedded Systems

The Exam Consists of **42** Questions in **6** Pages. ***Maximum Marks: 42 Marks*** **1 / 6**

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 to 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 to 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 half word aligned, each location in memory is

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

10. The operations of the stack should be performed -------- the allocated area.

A) inside	B) outside	C) inside and outside	D) None

11. In stack,

A) the number of pushes should be more than number of pops	B) the number of pushes should be less than number of pops
C) the number of pushes should be equal to number of pops	D) None

PROG1: Q12-Q16

```
        AREA READ_variables, DATA, READONLY
A       DCD 4
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   STR R3, [R4]
9   MUL R3, R3, R2
10  LDR R4, =X
11  END
```

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

12. In PROG1, what is the correct order for the above program to calculate X=(A+B) x C?

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

13. In PROG1, what is the value of R0 at the end of the program based on the selected order in Q12?

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

14. In PROG1, what is the value of R1 at the end of the program based on the selected order in Q12?

A) 0	B) 2	C) 4	D) 3

15. In PROG1, what is the addressing mode of "LDR R0, [R4]"?

A) Indexed addressing mode	B) PC-Relative addressing mode
C) Immediate addressing mode	D) None

16. In PROG1, what does "A DCD 4" mean?

A) Allocate 4-word locations in the memory	B) Allocate one word location with value "4"
C) Allocate unintialized 4 bytes in the memory	D) None

17. Stack is a form of,

A) Last In First Out (LIFO)	B) First In First Out (FIFO)	C) Both A and B	D) None

18. If the initial register contents of R0, R1 and R2 were R0= 0x00000000, R1= 0x02040608, R2= 0x10305070. After one of the operations below was performed on R1 and R2, R0 would be modified to 0x12345678 (R0 = 0x12345678).

What was the operation performed on the contents of R2 and R1?

A) AND	B) ORR	C) BIC	D) MUL

19. Status of Z flag after the execution of CMP instruction on R0 and R9 is ---- when R0 = 12 and R9 = 12.

A) Z=1	B) Z=0	C) Same as previous value	D) None

20. Assume the stack pointer (SP) is initialized to 0x20000408. Registers R0, R1, R2 and R12 are initialized to 12, 3, 8 and 5 respectively. What is the content of the stack (from top of stack to bottom) after the following sequence of operations?

```
PUSH {R0}
PUSH {R1-R2}
PUSH {R12}
```

A) 12, 3, 8, 5	B) 5, 3, 8, 12	C) 5, 8, 3, 12	D) None

21. What is the stack pointer value after the operations done in Q20?

A) 0x200003F8	B) 0x200003FC	C) 0x20000400	D) None

22. Based on the state of the stack after executing the operations in Q20, what are the contents of R3 and R4 after the POP {R3-R4} operation?

A) R3=5, R4=3	B) R3= 12, R4=3	C) R3=3, R4=5	D) None

23. What is the stack pointer value after the operation done in Q22?

A) 0x200003F8	B) 0x200003FC	C) 0x20000400	D) None

PROG2: Q24

```
        MOV R0, #1
        MOV R1, #0
        BL func1
        ADD R1, R0, #4
loop    B loop
func1
        ADD R0, R0, #2
        BL func2
        ADD R0, R0, #4
        BX LR
func2
        ADD R0, R0, #3
        BX LR
```

24. In PROG2, what is the value of R1 after running this code?

A) 10	B) 5	C) 0	D) 14

PROG3: Q25-Q26

```
        MOV R0, #1
        MOV R1, #0
        BL func1
        ADD R1, R0, #4
Loop    B Loop
```

```
func1
        ADD R0, R0, #2
        B func2
        ADD R0, R0, #4
        BX LR
func2
        ADD R0, R0, #4
        BX LR
```

25. In PROG3, what is the value of R1 after running this code?

A) 10	B) 11	C) 0	D) 14

26. In PROG3, what is the addressing mode of "BL func1"?

A) Indexed addressing mode	B) PC-Relative addressing mode
C) Immediate addressing mode	D) None

PROG4: Q27-Q34

```
        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, #2              ; STEP 4
        str     r4, [r0]            ; STEP 5
        ldr     r1, =b              ; STEP 6
        mov     r4, #6              ; 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
```

27. In PROG4, what is the value of r2 at the end of the program?

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

28. In PROG4, what is the value of r3 at the end of the program?

A) 2	B) 6	C) 5	D) 7

29. In PROG4, what is the content of variable *b* in memory before calling function *func*?

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

30. In PROG4, what is the value of r2 after calling function *func*?

A) 7	B) 3	C) 4	D) 5

31. In PROG4, 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

32. In PROG4, 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

33. In PROG4, what is the value of SP after STEP-20?

A) s_b-8	B) s_b+12	C) s_b+4	D) s_b+8

34. In PROG4, "a space 4" means

A) Allocate 4 bytes for variable "a" in memory	B) Allocate one byte for variable a with value "4" in memory
C) Allocate 4-word locations in memory	D) None

PROG5: Q35-Q38

```
                AREA myConstData, CODE, READONLY
X               DCD 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

                AREA myVarData, DATA, READWRITE
N               DCD 0
                AREA   MYCODE, CODE, READONLY
ARR_SIZE        EQU             10
                LDR R0, =X              ; STEP 1
                MOV R2, #0              ; STEP 2
                MOV R3, #ARR_SIZE       ; STEP 3
L1
                LDR R1, [R0], #offset   ; STEP 4
                ADD R2, R2, R1          ; STEP 5
                SUBS R3, R3, #1         ; STEP 6
                BNE L1                  ; STEP 7
                LDR R0, =N              ; STEP 8
                STR R2, [R0]            ; STEP 9
dloop           b dloop                 ; STEP 10
                END
```

35. In PROG5, what is the expected immediate value that should replace the offset symbol?

A) 0	B) 4	C) 2	D) 1

36. In PROG5, what is the value of variable N after the execution of STEP-09 based on Q35?

A) 0x55	B) 0x37	C) 0x10	D) 0x30

37. In PROG5, what is the value of r0 after the first execution of STEP-04 (after first iteration)?

A) The same as previous value	B) R0+4	C) R0+2	D) R0+1

38. In PROG5, " ARR_SIZE EQU 10" means

A) Assign value 10 to symbol ARR_SIZE	B) Allocate 10 bytes for variable ARR_SIZE
C) Allocate 10 locations for variable ARR_SIZE	D) None

PROG6: Q39-Q42

```
        AREA myDATA, DATA,   READWRITE
t       DCD 0XE

        AREA myConstData, CODE, READONLY
            MOV R0, #1   ; STEP 1
            MOV R1, #2   ; STEP 2
            PUSH {R0}    ; STEP 3
            PUSH {R1}    ; STEP 4
            BL sum2      ; STEP 5
            POP {R0}     ; STEP 6
            POP {R1}     ; STEP 7
            LDR R1, =t   ; STEP 8
            STR R0, [R1] ; STEP 9
STOP        B STOP       ; STEP 10
sum2
            ;Missing Instruction     ; STEP 11
            ADD R0, R0, R1           ; STEP 12
            BL sum1                  ; STEP 13
            POP {LR}                 ; STEP 14
            BX LR                    ; STEP 15

sum1
            ADD R0, R0, R1           ; STEP 16
            BX LR                    ; STEP 17
            END
```

39. In PROG6, what is the missing instruction in STEP-11 to make the code works correctly?

A) POP {LR}	B) PUSH {R0}
C) PUSH {LR}	D) None

40. In PROG6, what is the result of R0 after executing STEP-17?

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

41. In PROG6, what is the result of r0 after executing STEP-06?

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

42. In PROG6, where is result value of function sum1 is saved?

A) R1	B) R0	C) In the stack	D) None

END of Exam

Examination Committee

Exam Date: 2nd of April, 2022

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