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ECE 266 Introduction to Embedded Systems
Summer 2022
Midterm Exam

Last Name (printed) _____

First Name (printed) _____

Lab Section _____

Instructions:

- Open book, open notes. Only the textbook, lecture slides, any hand-written notes, and a A4-sized cheat sheet are allowed.
- Calculator allowed. No computers or smartphones are allowed.
- Make assumptions if necessary.
- This is a 1:30 min exam worth : 50 points

- **If required, you must explain your answers or show the solving process**

Q1. 5 points

a. Does Tiva C belong to the Von Neumann architecture? Answer Yes or No.

b. Does Tiva C have a RISC-type CPU? Answer Yes or No.

c. What is the number of CPU pipeline stages in Tiva C?

d. **ARM cortex -M0, M0+, and M1 are Harward Architecture. (True or False)**

e. **PSR(Program Status Register) is the combination of EPSR , IPSR and APSR (True or False)**

Q2. (10 points) Each Question 5 points

a. Convert the following signed integers into 8-bit binary and in Hexa decimal value.

1. -130
2. -2

b. What are the overflow and carry flags in the following operations with 8-bit binary numbers?

	Carry	Overflow
11110000 + 00001111		
01111111 + 00000001		
10000000 - 10000000		

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Q3. (10 points) Each Question 5 points

a. If r1=0b00010100 , then what is the value of r2 when CPU execute the following operations?

. 1. LSL r2, r1 #3
2. LSR r2, r1 #3
3. ROR r1,4

b. If r1 = 0b00010100
1. Show how to set bit number 6 using appropriate bitwise operation.
2. Show how to clear a bit number 5 using appropriate bitwise operation.

Q4. (15 points) Each Question 5 points

a. Register r0 holds 0xBBBB0000, and register r1 holds 0x0000CCCC. What is the value of r2 (in hex) after the CPU executes the following instructions? **Explain** for full credit.

```
1. ORR  r2, r0, r1
2. ORN  r2, r0, r1
```

b. Register r0 holds 0x20304050. What is the value of r1 (in hex) after the CPU executes the following instruction? **Explain** for full credit.

```
1. REV    r1,r0
2. REVSH  r1,r0
```

c. What does "ALIGN 4, 3" means ? Draw the memory layout if the data memory starts 0x20800000.

```
    AREA Middata , DAdTA, AlIGN = 2;
    ALIGN
a   DCB 0xA1B1C1D1
    ALIGN 4,3
b   DCB 0xAF
```

Q5. (10 points) Each Question 5 points

a. Register r1 holds a C variable `x` of `unsigned int` type. Translate the following C statement to **a single assembly instruction**, but do NOT use any multiply instruction. Hint: You may need to use a special subtraction instruction.

```
x = x * 15;
```

b. Register r0, r1 hold C variables `x`, `y` of **`int`** type. Translate the following C statement to assembly. This is not a function. You may use any free registers. Note: In C, `int` means `signed int`.

```
x = (x+y) / (x - y);
```

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