1. If the words at addresses 0x22000000 through 0x23FFFFFF are the bit-banded alias of the bits at addresses 0x20000000 through 0x200FFFFF (the bit-banded region), (**Note: comment** the solutions to problem (1) before the program in problem (2).)

(1) (a) give the bit-banded alias address of bit 12 in a word at address 0x20025000.

(b) give the bit (its bit number and its word address) to be accessed in the bit-banded region if its bit-banded alias address is 0x226C4018.

(2) write a programthat includes 2 subroutines **Get\_Alias** and **Get\_Region** (both using **an empty ascending stack**, with SP=0x40000030 initially, to avoid the side effect)**,** and calls to the two subroutines.

(a) Subroutine **Get\_Alias** computes the bit-banded alias address and puts it in R0. Assume the address of a word in the bit-banded region and the bit number in the word to be accessed are respectively given in R1 and R2 before calling Subroutine **Get\_Alias**. (**use (1)(a) as a test case to show the execution results**.)

(b) Subroutine **Get\_Region** computes the address of a word in the bit-banded region and the bit number in the word to be accessed, and put them respectively in R3 and R4. Assume the bit-banded alias address is in R5 before calling Subroutine **Get\_Region**. (**use (1)(b) as a test case to show the execution results**.)

(3) Write a program that includes two **subroutines** **GW\_PR** and **GW\_NPL** respectively for (a) and (b) below to get the width of an 8-bit interrupt priority register (address 0x4000098C) and put the width in R6. (All using **an empty descending stack**, with SP=0x40000120 initially, to avoid the side effect)and **calls to the subroutines**. (**be sure to find a way to show the result when the width is 7)**.

(a) using LSR with test pattern LSR

(b) using LSL without test pattern LSL

2. (1) The Tiva Launchpad board has a multi-colored LED that is controlled through three GPIO lines on Port F, one for red, one for green, and one for blue. The red LED is attached to line **PF2**, the green LED is attached to line **PF5**, and the blue LED is attached to line **PF8**. Write a program to showcase all three colors by create a loop that selects one color at a time, cycling through all three (in the cycle of **BLUE**, **GREEN, RED, RED, GREEN, BLUE**) by changing the value being written to the port. (Hint: Related base address 0x40000000 and offset 0x38 and **be sure to show the delay time between two lights and try to set the delay time to 2 seconds**.)

(2) Consider an interrupt being caused by a **32-bit** timer (the 16/32-Bit Timer 0A in the Tiva TM4C1233H6PM Microcontroller) counting down to zero in EXAMPLE 15.4.

(a) Write a sequence of instructions to set the match value if the timer is required to expire in **8 second** and the frequency of the system clock is set to 16MHz**.** (Hint: Store the matching value in the register at base address 0x40000000 and offset 0x30.)

(b) write a programthat includes Subroutine **Get\_MatchValue** (using **a full descending stack**, with SP=0x40000120 initially, to avoid the side effect)**,** and calls to the subroutine. Subroutine **Get\_MatchValue** computes the match value and put it in R0. Assume the number of seconds to expire and the system clock frequency in MHz are respectively in R1 and R2 before calling the subroutine (suppose both numbers are **integers** and **be sure to use (2)(a) as a test case to show the execution results**).

**Note:** Please

1. put necessary **Keil Tool window screenshots** to show your **program** and **execution results** including **highlighted necessary initial assumptions and subsequent memory, register and stack changes**,
2. **comment student ID+your English name in every screenshots**, and
3. put reports into one word file named by student\_ID+your\_name.