**QUESTION 8. (10 points)**

*For the questions below, write the code using the masks that are pre-defined in the header file. (E.g: BIT0:0000 0001, BIT1:0000 0010, …, BIT7:1000 0000).*

Perform the operations below on the 8-bit variable (uint\_8t data).

Part a) Write code that performs the three operations below. Perform each operation independently of the other

Set bit 6

|  |
| --- |
| data = BIT6; |

• Clear bit 6.

|  |
| --- |
| data &= ~BIT6; |

• Invert bit 6.

|  |
| --- |
| data ^= BIT6; |

Part b) Write code that performs the three operations below. Perform each operation independently of the others.

• Set bits 4 and 5.

|  |
| --- |
| data = (BIT4 | BIT5); |

• Clear bits 4 and 5.

|  |
| --- |
| data &= ~(BIT4 | BIT5); |

• Invert bits 4 and 5.

|  |
| --- |
| data ^= (BIT4 | BIT5); |

• Set bit 4 and clear bit 5.

|  |
| --- |
| data |= BIT4;  data &= ~BIT5; |

Part c) Write an if-condition line for each of the cases below. Perform each operation independently of the others.

• Check if bit 2 is 1.

|  |
| --- |
| If ((data & BIT2) == BIT2){  } |

• Check if bit 2 is 0.

|  |
| --- |
| If ((data & BIT2) == 0){  } |

• Check if bits 3,4 are 1,1.

|  |
| --- |
| If ((data & (BIT3|BIT4)) == (BIT3|BIT4)){  } |

• Check if bit 3 is 0 and bit 4 is 1.

|  |
| --- |
| If ((data & (BIT3|BIT4)) == BIT4){  } |

• Check if bits 3, 4 are 0,0.

|  |
| --- |
| If ((data & (BIT3|BIT4)) == 0){  } |

**QUESTION 9. (10 points)**

A module on the microcontroller is configured using a control register called CTL that has the format shown below.

|  |  |  |  |
| --- | --- | --- | --- |
| SLP | CLK | CAP | IE |
| 2- | 3- | 2- | 1- |

* SLP: selects sleep mode; value between 0 and 3
* CLK: selects clock speed; value between 0 and 7
* CAP: selects built-in capacitor value; choice between 0 and 3
* IE: interrupt enable bit (1: enable/ 0: disable)

To support programming the device, the environment has declared the symbolic constants:

SLP\_3: 1100 0000

SLP\_2: 1000 0000

SLP\_1: 0100 0000

SLP\_0: 0000 0000

CLK\_7: 0011 1000

CLK\_6: 0011 0000

…

CLK\_0: 0000 0000

CAP\_3: 0000 0110

CAP\_0: 0000 0000

IE: 0000 0001

*Perform all the operations below using the masks defined above.*

Part a) Write a line of code that configures the module as the following:

(Sleep mode 2)(Clock speed 6)(Capacitor value 1)(Interrupts enabled)

|  |
| --- |
| CTL &= (SLP\_2|CLK\_6|CAP\_1|IE); |

Part b) For the operation above, show the masks used and the final value of CTL in binary.

|  |
| --- |
| SLP\_2 = 1000 0000  CLK\_6 = 0011 0000  CAP\_1 = 0000 0010  IE = 0000 0001  Final Value  CTL = 1011 0011 |

Part c) Write a piece of code that changes SLP to 1. The current value of SLP is unknown.

|  |
| --- |
| We first AND to clear the bits previous in the SLP, then we can OR the bits back onto the variable  CTL &= ~SLP\_3;  CTL |= SLP\_1; |

Part d) Write a piece of code that changes CLK to 5. The current value of CLK is unknown.

|  |
| --- |
| We first AND to clear the bits previous in the CLK, then we can OR the bits back onto the variable  CTL &= ~CLK\_7;  CTL |= CLK\_5; |

Part e) Write an if-condition line that checks if SLP=1.

|  |
| --- |
| If ((CTL & SLP\_3) == SLP\_1)){    } |

Part f) Write an if-condition line that checks if CLK=5.

|  |
| --- |
| If ((CTL & CLK\_7) == CLK\_5)){    } |

Part g) Write an if-condition that checks if the current value of CLK is either of (0, 2, 4, 6).

|  |
| --- |
| If ((CTL & CLK\_7) == CLK\_0 | (CTL & CLK\_7) == CLK\_2 | (CTL & CLK\_7) == CLK\_4 | (CTL & CLK\_7) == CLK\_6 | ){    } |