**Objective:** You will outline, flow chart and write three short programs that use C-language data type variables, assignment, control flow logic and functions to interface with microcontroller I/Os 8-bit dip switches and 8-bit LEDs on our training board. And use Bitwise logic to manipulate and evaluate individual I/O bits.

Warm-up:

*Use Lecture slides for reference.*

*Make sure to complete Lab 07 Pre-Lab Work, then answer the following questions.*

1. *Properly define a variable that will store bit patterns read from an I/O port/register?*

*Answer:*

1. *Provide an example of a C-Language bit logic statement to clear Bit 5 without affecting other bits of an 8-bit value?*

*Answer:*

1. *Provide an example of a C-Language bit logic statement to set Bit 2 without affecting other bits of an 8-bit value?*

*Answer:*

1. *How do you write a C-Language delay loop using 300 as the counter?*

*Answer:*

Warm-up exercise Check Point

Lab Instructions:

You will write three short programs:

* Each short C-Language program should be designed using the *Program Development Cycle worksheet steps 1-3 (for C-Language programming)*.
* Each short program should be in one Project named yourLastName\_Lab07
* Comment each program as **program 1**, **program 2**, and **program 3**.
* Write programs 1 and 2 in the main function and make use of the endless “for loop” generated by CodeWarrior IDE.
* Comment out each program once completed.
* For program 3, write your decision structure inside the endless “for loop”.
  + And write your function call inside the endless “for loop” and below the main () function.
  + Do not forget the function prototype (because CodeWarrior won’t)!
* 8-bit dip Switches: Port B (use pre-defined name: PORTB)
* 8-bit LEDs: Port C (use pre-defined name: PORTC) o Data direction register (use pre-defined name: DDRC)
* Code Commented Header
  + As exampled in the *CodeWarrior program shell code organization section of the Program Development Cycle worksheet C-Language*
* \*\*\*\*\* Outline each program before writing the code! \*\*\*\*\*\*\*

**program 1**. Flow chart and then write a C language program that reads the 8-bit switches, clears bit 5 of the value read and then writes the modified value to the LED port. Other bits read from the switches should remain unchanged. Include a delay loop function.

Before you write the code: Flow chart this logic.

Check Point: program 1 flow chart

**program 2**. Flow chart and then write a C language program that reads the 8-bit switches, sets bit 2 of the value read and then writes the modified value to the LED port. Other bits read from the switches should remain unchanged. Be sure to include a delay loop. Make sure to Comment out program 1.

Before you write the code: Flow chart this logic.

Check Point: program 2 flow chart

**program 3**. Design and then write a C language program that calls a function (C function call) and passes an arbitrary number (0 - 7) that is used to specify which bit of the switches to check if high or low. The subroutine should receive the number and use **decision logic switch case** to determine which value was passed in and set the appropriate mask value. Once the mask value is determined, then, use the mask value to check the switches and determine if the specified switch is high or low. If the specified switch state is high (one, on), the function will return a one (1), otherwise, if the specified switch bit is low (zero, off) the function will return a zero (0). Please re-read the previous sentence at least once. The function is passed a volatile unsigned character as the argument and it returns an unsigned character. The main function that calls the other function should use the returned value to either turn “on” all of the LEDs if a 1 (true) is returned or turn off all of the LEDs if a 0 (false) is returned. Make sure to Comment out program 2.

Before you write the code: Complete Steps 1-3 *Program Development Cycle worksheet C-Language.*

|  |  |
| --- | --- |
| Check Point |  |
| *program outline checked!* | |

*It is easy to do this program wrong so be sure to Have your flow chart and* Then do Steps 4- 6

Demonstrate this program to the Instructor or TA.

Check Point: program 3 design and flow chart

Your three program sections should be included in your single CodeWarrior project named yourLastName\_Lab07.

**Write: your report for this Canvas assignment:**

* Word document no more than a few pages, well formatted with: Your name, lab section #, lab assignment #, and date, (save your .docx as YourLastName\_Lab##). (wherer ## is the lab number)
* Include sections:
  + - **Objective** (in your own words), o **Procedure** (one short concise paragraph),
    - **Answers to questions** (clearly identify the question and your answer. *Ensure your answers are indicated in highlight, red, or some means to indicate the answer from the instructions*). o **Programs:** This section would include program 1 and 2 flow charts and program 3 design and flow chart as stated in the instructions. Clearly mark and all program flow charts and part 3 entire program outline as instructed in lab assignment.
    - **Conclusion**: Summarize what you have learned and observed. Include discussion on C language and reading and writing to I/Os. Do not be vague on this reflection as you must convey to me you understand what you have done and can provide, in detail, examples for your statements. Don’t just say I did this and then I did this….etc. Use critical thinking when writing your thoughts and observations and provide specific examples. o Make sure to view lab assignment and rubric for additional report criteria instructions.

**Submit:** to this Canvas assignment by due date.

* 1. Your completed report with all completed sections as instructed including design outline and flow charts in proper section as instructed.
  2. Your main.asm file completed, fully commented program (just the main.c file) o Be sure your code is well organized, includes a commented header, and logical comments and each Part clearly noted.