

CPEG 330 – Microprocessors and Interfacing – Spring 2021 – Exam 1

Name: _____

ID Number: _____

Question	Course Learning Outcome (CLO) covered by the question
Q1	2- Write assembly language programs using the various addressing modes and data transfer instructions of the PIC microcontroller.
Q2	1- Understand the architecture and internal operations of the PIC microcontroller.

- Q1. [35 marks]** Write a program that reads a number X from PORTB, calculate the value $4 \times X - 1$, then store the result in memory. The program repeats this operation 20 times. The results are stored in an array in memory starting at address 0x30. The program accepts a new number every time a button connected to RA0 is pressed and released. When all 20 elements are filled, the program turns on a LED connected to RA1 then exits.

- Q2. [40 marks]** Answer the following questions:
- a. **[10 marks]** Briefly explain each of the following terms:
 - i. **[2.5 marks]** A microprocessor-based system.
 - ii. **[2.5 marks]** A microcontroller.
 - iii. **[2.5 marks]** The Harvard memory architecture.
 - iv. **[2.5 marks]** A reset vector.

- b. **[15 marks]** Fill in the following table showing the values of the different registers and flags after the execution of every instruction. The file registers contents and flags values are carried forward from one instruction to the next. Initially, you have the variable X = D'136' and W = D'60'. The initial values of all flags are shown in the table below. Please show how you reached the provided answers below the table. Fill in the values for X and W in hexadecimal format. Variable X is defined using the statement (X equ 0x0C).

Instruction	X	W	Z	DC	C
			0	0	1
RRF X, 1					
ADDWF X, 1					
ADDLW D'50'					
SUBWF X, 0					
SUBLW X					

- c. **[5 marks]** Write a macro to perform the operation specified. The macro should be used as follows:

SUBLF F1, L ; F1 = F1 - L

- d. **[10 marks]** Calculate the total delay that would be generated by calling the subroutine below assuming a 2 MHz oscillator.

DELAY	MOVLW	D'131'
	MOVWF	j
	GOTO	DEL
DEL	NOP	
	DECFSZ	j, 1
	GOTO	DEL
	RETURN	