**Repeat Lab 4 Micro Controller Memory Components**

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Answer the following Questions and Upload completed word document to Moodle.

1. **Explain what is the PIC 16F877 Register file and how it leads to an Orthogonal Instruction Set.**

The PIC 16F877 Register File is a collection of registers used to store data and control the microcontroller's operations. It includes General Purpose Registers (GPRs) for temporary data storage and Special Function Registers (SFRs) for controlling hardware components. An Orthogonal Instruction Set allows instructions to operate on any register uniformly, regardless of its type. The PIC 16F877's register file supports this by enabling consistent operations across different registers, making programming easier and more flexible.

1. **Discuss each of the following registers encountered in PIC 16F877:** 
   1. **W Register**

The W Register (Working Register) is a key accumulator in the PIC 16F877, used for arithmetic and logic operations. Data is often moved in and out of the W register to perform calculations or to transfer data between registers and memory.

* 1. **Program Counter (PC).**

The Program Counter (PC) is a register that holds the address of the next instruction to be executed. It automatically increments after each instruction, ensuring the sequential execution of the program unless altered by control flow instructions like jumps or calls.

1. **By means of a diagram show the ALU structure of the PIC16F877.**

The ALU (Arithmetic Logic Unit) of the PIC16F877 performs arithmetic and logic operations. The basic structure includes:

* Input Registers: W Register and data from the file register.
* ALU Operations: Performs operations like addition, subtraction, AND, OR, and shifts.
* Status Register: Updates flags like Zero, Carry, and Digit Carry based on the ALU result.
* Output: The result is stored back in the W Register or a file register.

1. **What is the advantage of using flash program memory in the PIC 16F877?**

Flash Program Memory is non-volatile memory that retains its content even when the power is off. The main advantage is that it allows for the program to be easily erased and reprogrammed multiple times, making it ideal for development and iterative testing.

1. **Explain the purpose of the data memory in the PIC 16F877**

The Data Memory in PIC 16F877 stores the data used by the CPU during program execution. It includes both GPRs for storing temporary variables and SFRs for controlling hardware operations.

1. **Explain the difference between the data memory and the program memory on the PIC 16F877**

* Data Memory: Stores variables and temporary data; it is volatile and includes both GPRs and SFRs.
* Program Memory: Stores the instructions that the CPU executes; it is non-volatile (Flash memory) and contains the machine code for the program.

1. **Explain the status register and list some of the events it reports/monitors**

The Status Register is a special function register that contains flags indicating the result of arithmetic operations (Zero, Carry, Digit Carry, etc.). It monitors events like overflow, zero result, and carry from arithmetic operations, which are crucial for decision-making in programs.

1. **Explain the difference between the Special Function Registers (SFR) and General Purpose Registers (GPR).**

* Special Function Registers (SFRs): Control and monitor the operation of the microcontroller's peripherals (e.g., I/O ports, timers, ADC).
* General Purpose Registers (GPRs): Used for storing temporary data and variables during program execution.

1. **Explain E2PROM.**

EEPROM (Electrically Erasable Programmable Read-Only Memory) is non-volatile memory used to store data that must be retained even after the microcontroller is powered off. It is typically used to store calibration data, configuration settings, or user data.

1. **Outline the critical role that the status register plays in a RISC processor.**

The Status Register plays a critical role in a RISC processor by holding flags that indicate the results of operations (like Zero, Carry, Overflow). These flags are essential for making decisions in conditional instructions, ensuring efficient and accurate program flow.

1. Describe how the AVR Mega 328p handles input/output and compare its implementation to the PIC

The AVR Mega 328p handles I/O through port registers (like PORTB, DDRB, PINB) that control the direction and state of I/O pins. In contrast, the PIC uses TRIS and PORT registers. While both handle I/O similarly, the AVR tends to have a more intuitive and user-friendly register naming and structure.

1. Outline the features of the AVR Memory and it’s components

The AVR memory includes:

* Flash Memory: Stores program code.
* SRAM: Stores runtime data and variables.
* EEPROM: Stores non-volatile user data.

1. Describe the AVR Flash memory

AVR Flash Memory is non-volatile memory where the program code is stored. It allows for easy reprogramming and retains the code even when the power is turned off.

1. Describe AVR ALU

The AVR ALU (Arithmetic Logic Unit) performs arithmetic operations (like addition, subtraction) and logic operations (like AND, OR, NOT). It interacts with the General Purpose Registers to perform these operations, typically in a single clock cycle, contributing to the AVR's efficiency.

These answers provide a concise yet comprehensive explanation of each aspect of the PIC 16F877 and AVR microcontrollers, offering a solid foundation for understanding their operations.