**Chapter 1**

**Questions and Assignments**

1. **List the components of a microprocessor-based system.**

* Microprocessor (MPU)
* Memory
* I/O (Input/Output) ports

1. **What is the difference between a microprocessor and a microcontroller?**

A microcontroller has peripheral embedded in it while we have to use external circuits in case of microprocessors. Also, a microcontroller contains a microprocessor embedded in it.

1. **Explain the difference between the terms: microprocessor, MPU, and CPU.**

Microprocessor and MPU are the same, which is a group of electronic circuits fabricated on a semiconductor chip that can read binary instructions written in memory and process binary data according to those instructions.

A CPU is the term that stands for Central Process Unit. The term CPU doesn’t specify the how is big it is or how is it created, but the MPU does specify.

1. **List the two major categories of memory and explain their functions.**

* Read/Write Memory (R/WM)
* Read - only – Memory (ROM)

1. **Define the terms: bit, byte, and word.**

* A “bit” is the smallest unit of storage. A bit stores just a 0 or 1.
* A “bite” is the collection of 8 bits.
* A “word” is the number of bits processed by a computer's CPU in one go (these days, typically **32 bits** or **64 bits**).

1. **Explain the functions of input and output devices with examples.**

* An input device transfer information to the microprocessor. An example of that can be the keyboard.
* Output devices are the way that a microprocessor use to show an information. An example of that can be a video screen.

1. **Is a scanner connected to a PC an input device or an output device?**

It is an input device, because it is transferring information to the PC.

1. **Explain the functions of address bus, data bus, and control lines.**

* **Address bus:** It is unidirectional, and it carries memory and I/O addresses.
* **Data bus:** It is bidirectional, and it transfers binary data and instructions between MPU and memory and I/O.
* **Control lines:** Read and Write timing signals asserted by MPU.

1. **Explain why the address bus is unidirectional and the data bus is bi-directional.**

The address bus is unidirectional because it only provides an address and does not take any input.

The data bus is bi-directional because creates a communication back and forward where it receives and provide data.

1. **Calculate the number of bits that can be stored in 1 KB memory.**

1 byte = 8 bits | 1KB = 1,024 bytes | **1KB = 8,192 bits**.

1. **Calculate the number of registers in 8 KB memory and the address of the last register in Hex (assuming the address of the first register is 0000).**

131072 registers. The last address in Hex would be 1FFFF.

1. **Calculate the number of registers in 4 MB memory and the address of the last register in Hex (assuming the address of the first register is 00000).**

8388,608 registers. The last address in Hex would be 7FFFFF.

1. **If the processor has a 12-bit address bus, calculate its memory addressing capacity.**

It can address to 4096 different locations.

1. **If the processor has a 21-bit address bus, calculate its memory addressing capacity.**

It can address to 2097152 different locations.

1. **If the last memory address in a given memory chip is 07FF H, calculate the size of the memory chip.**

07FF = 2047 | 2047 + 1 = **2048 = 11 bits**

1. **If the address range of flash memory in a microcontroller is 00000 H to 1FFFFH, calculate the size of the memory.**

1FFFF = 131071 | 131071 + 1 = **131072 = 17 bits**

1. **In a microcontroller, R/W memory is assigned the address range from 2000H to 21FFH. Calculate the size of the R/W memory.**

2000H - 21FFH = 1FF = 511 | 511 + 1 = **512** = **9 bits**

1. **How are the signed numbers represented in 8-bit MPU?**

The eighth bit (Bit 7) represents the sign of a number. 0 means positive, and 1 represents negative.

1. **Calculate the decimal value of the Hex integer 78H if it is an unsigned number.**

78H = 7(16) + 8 = **120D**

1. **Calculate the decimal values of the Hex integer 98 H if it is a signed number as well as if it is an unsigned number.**

98H = 9(16) + 8 = **152D**

1. **Calculate the Hex equivalent to represent a negative decimal number –12 10 in an 8-bit microprocessor.**

10001100B = **8CH**

1. **Find the Hex equivalent of the decimal number 13810 and show its binary representation in an 8-bit processor.**

Because the 8th bit represents the sign of the number, the range of positive numbers is up to 127.

1. **Find the Hex equivalent of the negative decimal number –138 10 and show its binary representation in an 8-bit processor.**

Because the 8th bit represents the sign of the number, the range of negative numbers is up to -128.

1. **Define ASCII code and explain why the total number of codes is limited to 128.**

ASCII It is a code for representing 128 English characters as numbers, with each letter assigned a number from 0 to 127.

The ASCII code is limited to 128 because around then (1960's), an 8-bit byte was becoming the standard way that computer hardware was built. The 8th bit was being used as a parity bit to detect transmission errors.

1. **Find the ASCII codes for upper-case letters A and Z, and lower-case letters a and z from Appendix E.**

* 65 is for A and 90 is for Z.
* 97 is for a and 122 is for z

1. **Given lower-case ASCII letters, suggest a logical operation to make them uppercase.**

Subtract 32 to the value for the lower-case letter.

1. **Explain why assembly language programs are efficient in execution.**

Because it is a low-level language that has a one-to-one correspondence with machines instructions. This allows the programmer to control the computer or microcomputer in a way that it will do exactly what the programmer wanted, working on an expected way.

1. **What is a major advantage of writing programs in a high-level language?**

The major advantage that we have writing programs in a high-level language is that they are written in statements of spoken languages.