به نام خدا
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سوال چهارم و پنجم از تسک ۱

سوال چهارم)

You know the basics about how the chip is clocked. Every microcontroller chip uses a clock, which keeps track of time for the chip, in general one assembly code instruction is run every clock cycle.

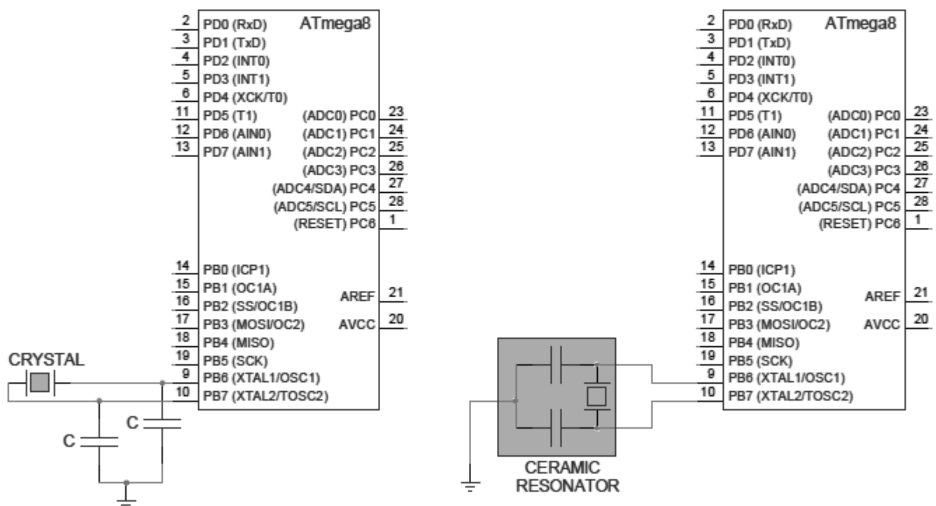
The Clock Source can be either of the following:

- Internal Clock
- External Clock

'Internal Clock' means the little oscillator inside the chip. This clock is good for most basic projects, but its not very precise. Having an internal oscillator means we don't need to wire up an external crystal and hence we can use the clock pins for other tasks. Literally, ' External Clock' means that a square wave is being input into the 'CLOCK-IN' pin, but this option is rarely used. If we need a special clock rate (for example 12MHz) we can use an external crystal or oscillator.

Crystals come in different pacakges, with the speed printed on the body, usually in MHz. Ceramic resonator is an alternative to the common crystal. Crystal is a 2-pin component, but ceramic resonator have 3 pins.

In practice, it is required to add two ceramic capacitors (usually 22pF value) with the crystal as shown in the next figure. However, this is not required incase of a ceramic resonator because it is a combination of the crystal and capacitors, built into one compact package. Note that the internal ATMega8 clock can be set up to a maximum frequency of 8 MHz, and beyond that you need an external clock source. How can we set a clock speed? As said, we have two options; use the internal one, or use an external source. If we are writing code for a basic job, the internal clock should suffice. On the other hand, when precision timing is crucial, we need an alternate method like using suitable crystals, or ceramic resonators.



The FUSE!

Fuses are important when it comes to uC programming, that is why fuses are well-documented in manufactures' datasheets. The fuses determine how the chip will act, whether it has a bootloader, what speed and voltage it likes to run at, etc.

You only need to set them once, but if you don't do this right, get ready to expect a costly disaster!

Typically, there are only two fuse bytes: a high one, and a low one. As you may well know, one byte contains 8 bits. So we have just 16 bits to set to on or off. Each of those bits, depending on whether they are on or off, impacts the critical operations of the microcontroller. For all fuses, '1' means unprogrammed, and '0' means programmed. As found in the datasheet, ATMega8 has the following clock source options, selectable by Flash Fuse Bits as shown in the table below.
The clock from the selected source is input to the AVR clock generator, and routed to the appropriate modules.

Device Clocking Option	CKSEL3..0
External Crystal/Ceramic Resonator	1111 - 1010
External Low-frequency Crystal	1001
External RC Oscillator	1000 - 0101
Calibrated Internal RC Oscillator	0100 - 0001
External Clock	0000

Fuse Bits – Short Reference

- Four bits controlling Atmega8 clock sources: CKSEL0, CKSEL1, CKSEL2, CKSEL3.
    - Different clock sources of Atmega8:
    - External Crystal or Resonator
    - External Low Frequency Crystal
    - External RC Oscillator
    - Calibrated Internal RC Oscillator
    - External Clock

- External Crystal (or Ceramic Resonator) may be set from 1010 to 1111. These ranges are left for user to select microcontroller startup times to stabilize oscillator performance before first instruction.
- If we connect external Crystal oscillator or ceramic resonator, there comes another Fuse bit CKOPT. This bit selects two different modes of oscillator amplifier. If CKOPT is programmed then Oscillator oscillates a full rail-to-rail output.If CKOPT is unprogrammed, the swing is smaller.
- The Oscillator can operate in three different modes, each optimized for a specific frequency range. The operating mode is selected by the fuses CKSEL3..1
- CKSEL0, SUT0 and SUT1 bits in this case are used to select startup times of microcontroller. These settings are necessary to ensure stability of ceramic resonators and crystals.

Start-up Times for the Crystal Oscillator Clock Selection

CKSEL0	SUT1..0	Start-up Time from Power-down and Power-save	Additional Delay from Reset (V_{CC} = 5.0V)	Recommended Usage
0	00	258 CK(1)	4.1ms	Ceramic resonator, fast rising power
0	01	258 CK(1)	65ms	Ceramic resonator, slowly rising power
0	10	1K CK(2)	–	Ceramic resonator, BOD enabled
0	11	1K CK(2)	4.1ms	Ceramic resonator, fast rising power
1	00	1K CK(2)	65ms	Ceramic resonator, slowly rising power
1	01	16K CK	–	Crystal Oscillator, BOD enabled
1	10	16K CK	4.1ms	Crystal Oscillator, fast rising power
1	11	16K CK	65ms	Crystal Oscillator, slowly rising power

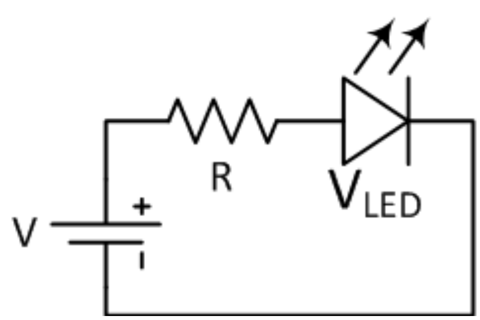
سوال پنجم)

TABLE 2-1 5-mm LED Electrical and Optical Characteristics (Lite-On Optoelectronics)					
Color	**Forward Current I(av)**	**Peak Current I(pk)**	**Typical Forward Voltage V(led)**	**Viewing Angle**	**Wavelength**
Red	20mA	120mA	2.0V	30	635nm
Orange	20mA	60mA	2.05V	15	624nm
Yellow	20mA	90mA	2.0V	20	591nm
Green	20mA	100mA	3.5V	15	504nm
Blue	20mA	100mA	3.7V	20	470nm
White	20mA	100mA	3.5V	20	Wide spectrum

An LED (Light Emitting Diode) emits light when an electric current passes through it. The simplest circuit to power an LED is a voltage source with a resistor and an LED in series. Such a resistor is often called a ballast resistor. The ballast resistor is used to limit the current through the LED and to prevent that it burns. If the voltage source is equal to the voltage drop of the LED, no resistor is required. The resistance of the ballast resistor is easy to calculate with Ohm's law and Kirchhoff's circuit laws. The rated LED voltage is subtracted from the voltage source, and then divided by the desired LED operating current:

$$R = \frac{V - V_{LED}}{I}$$

Where V is the voltage source, VLED is the LED voltage and I the LED current. This way you can find the right resistor for LED.



LEDs are also available in an integrated package with the correct resistor for LED operation. This simple circuit might be used as a power-on indicator for a DVD player or a computer monitor. Although this simple circuit is widely used in consumer electronics, it is not very efficient since the surplus of energy of the voltage source is dissipated by the ballast resistor. Therefore, sometimes more complex circuits are applied with better energy efficiency.