First lecture

Elements of light propagation theories

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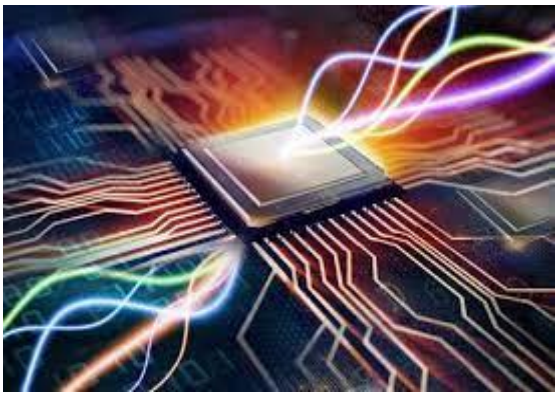
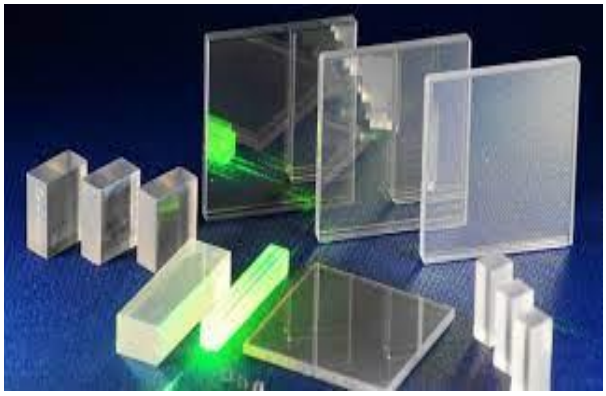
Introduction

Light is electromagnetic radiation. The word light is used to denote radiation that may be visible to the human eye or invisible. In fact, as we will see later, only a very small portion of the electromagnetic spectrum lies in the visible range.





Wave Nature of Light

This theory posits that light travels in waves. Waves resulting from the superposition of many sine waves, they are termed as wave packets. Each wave itself is characterized by a crest (peak) and a trough (ebb or valley). The time it takes for the wave between two successive crest (or trough) appearances is termed the time period (T). The distance at which the wave repeats itself is called the wavelength, denoted by the Greek letter λ (lambda). Wavelength can be measured from crest to crest, trough to trough as shown in Figure (1).

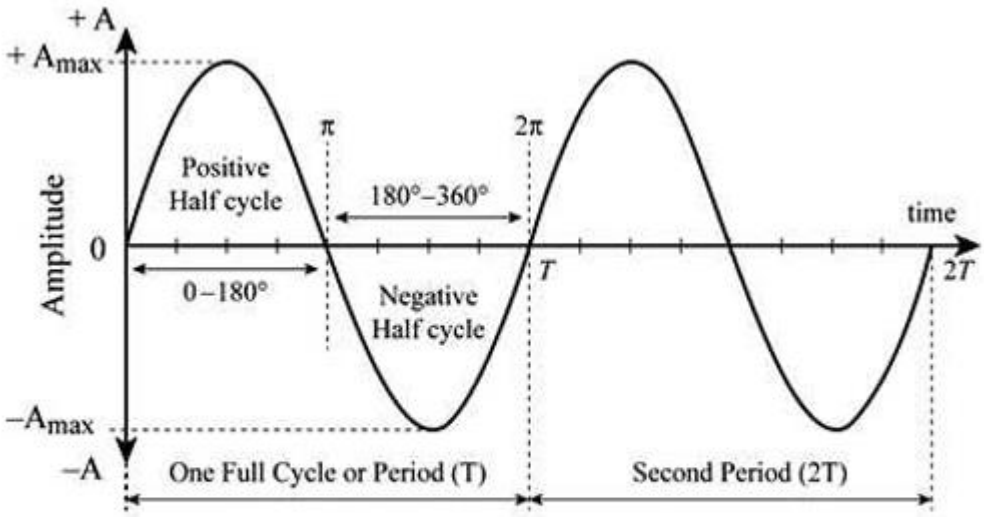


Fig. (1): the wave motion

In one complete cycle, the wave advances a distance λ during a time period T. From early on, we know that, Speed = distance divided by time. Using this relationship, we obtain

$c = \lambda / T$ ……..(1)

Where c is the speed of light (in vacuum $c = 3x10^8$m/sec).

The number of times a wave repeats itself over a specified period is called frequency. There is an inverse relationship between time and frequency. If we denote the frequency using the Greek letter γ (pronounced "new"), then

$\gamma = 1/T$ or $T = 1/\gamma$ …….(2)

When T is measured with the base unit of second (s), the reciprocal ν is in reciprocal seconds (s^{-1}), or per second, or cycles per second (cps), or Hertz(Hz). Substituting for T in the equation for c, we obtain

$c = \lambda\gamma$ or $\gamma = c/\lambda$ or $\lambda = c/\gamma$ …….(3)

visible light occupies a wavelength range of 400-700 nm (1 nm = 1 billionth of a meter.) Figure (2) show the electromagnetic spectrum

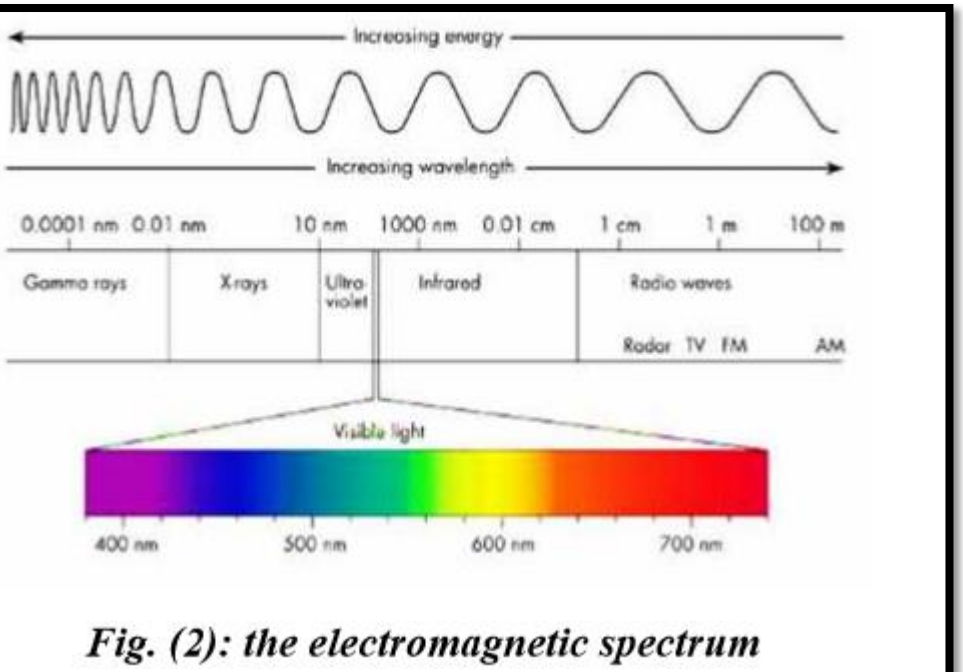


Fig. (2): the electromagnetic spectrum