EC210 – Solid State Electronics
Lab 3
Traveling Wave

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Class : Solid State Electronics - EC210, Spring 2015
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Outline

- Traveling wave
- Solar cells
- Photo-sensors
- Assignment on Traveling wave !
- Project on Photo-sensors !

Waves

- **Types of Waves :**

Waves can be classified into two types

1. **Mechanical wave:**

   It is the propagation of disturbance through the medium due the repeated periodic motion of the particles.

   Ex: Sound waves, vibration of a string and water waves

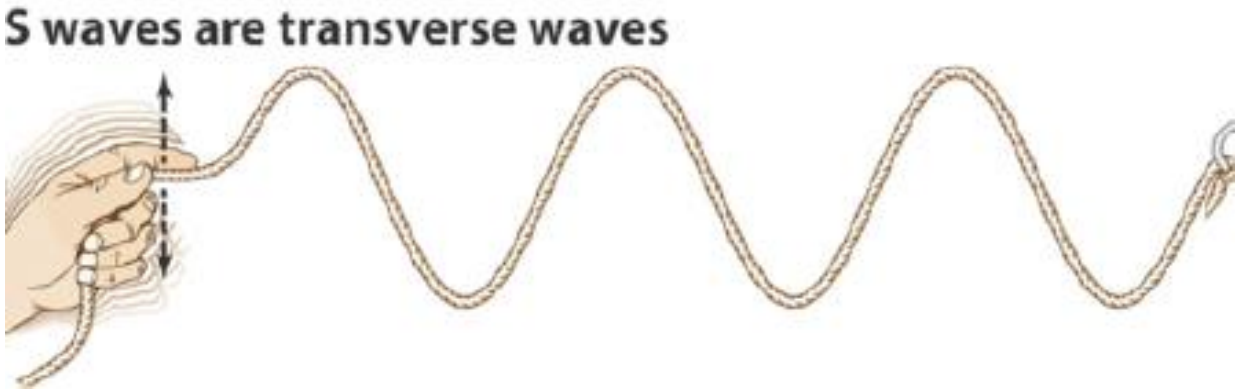
   ❖**Its also classified into two types of waves**

http://hyperphysics.phy-astr.gsu.edu/hbase/sound/trawvcon.html

Mechanical Waves Types

- **A. Transverse Waves:**

  It is the wave which the vibration of the particles in the direction **perpendicular** to the direction of the propagation.

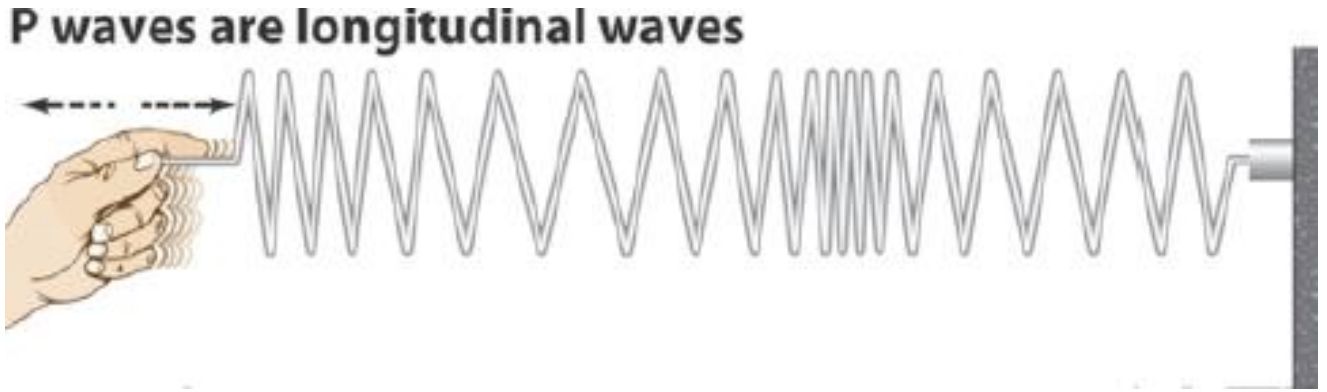


http://hyperphysics.phy-astr.gsu.edu/hbase/sound/trawvcon.html

Mechanical Waves Types

- **B. Longitudinal Waves:**

  It is the wave which the vibration of the particles **in the direction** of the propagation.



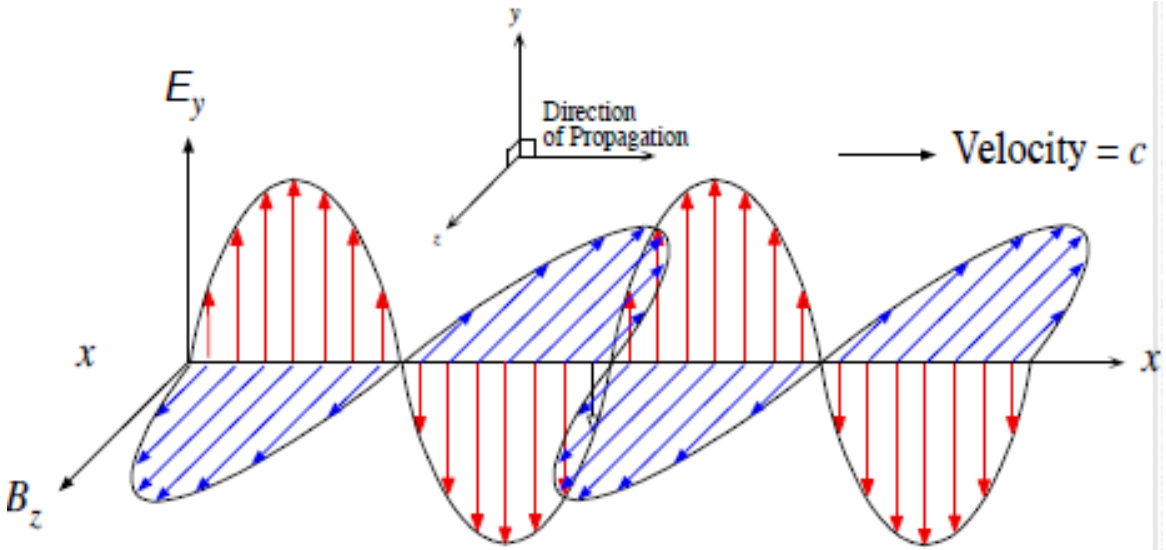
http://hyperphysics.phy-astr.gsu.edu/hbase/sound/trawvcon.html

Waves

2. **Electromagnetic wave: "Traveling wave"**

It is the wave that can pass through the vacuum. It's formed by the propagation when the Electric and magnetic field fluctuate together.

Ex: Light waves, radio waves and x-rays.



The classical view of light as an electromagnetic wave. An electromagnetic wave is a travelling wave which has time varying electric and magnetic fields which are perpendicular to each other and to the direction of propagation.

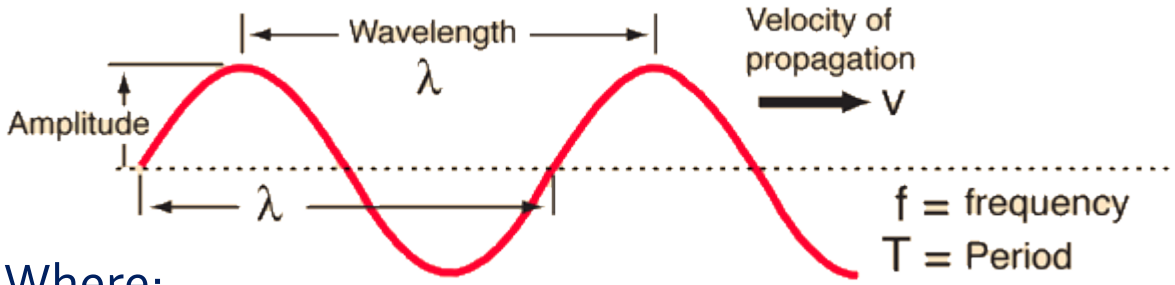
http://elektroarsenal.net/light-waves-in-a-homogeneous-medium.html

Electromagnetic Wave "Traveling Wave"

- **Traveling wave:**

It can be described by the following mathematical function.

$$y(x,t) = A\sin(kx - \omega t + \varphi)$$

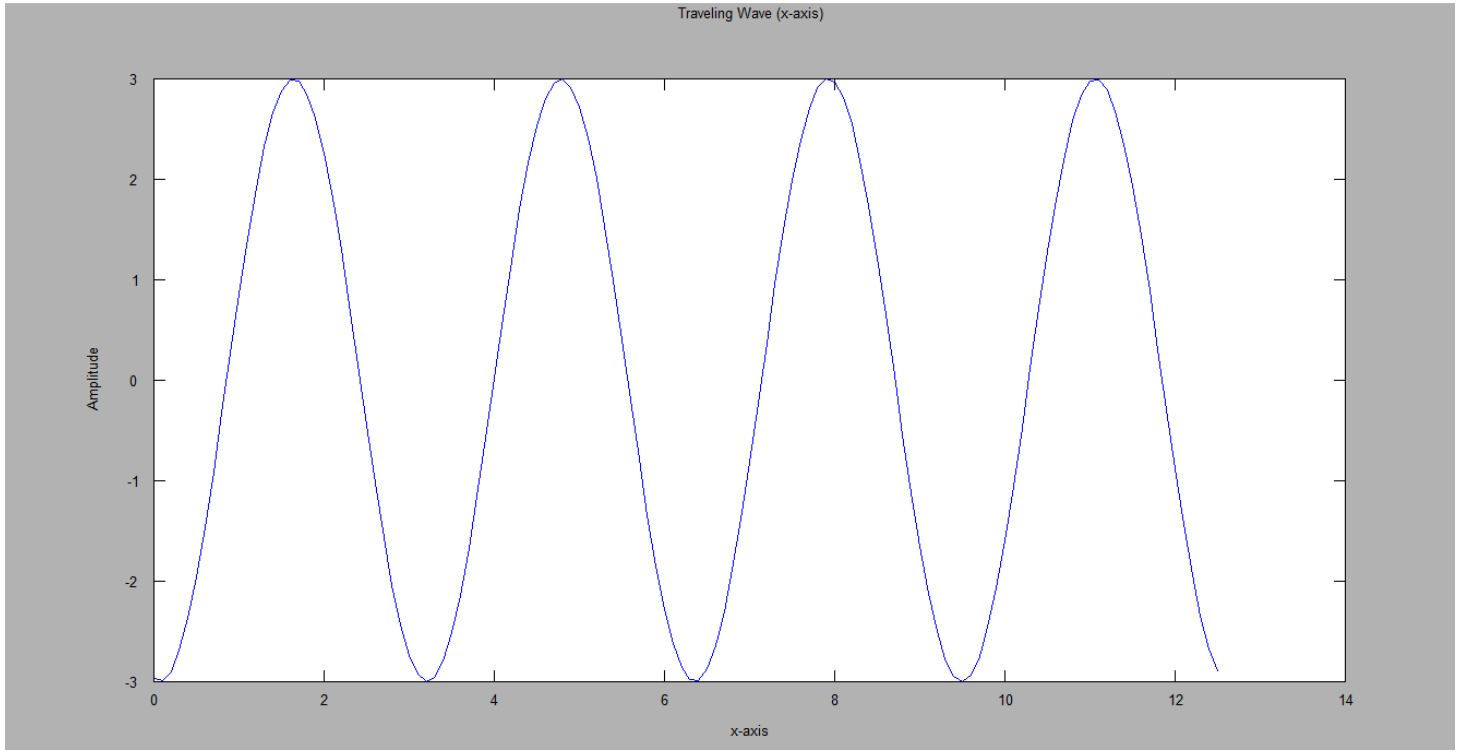


- Where:
  - A : is the amplitude of the wave
  - K : is the wave number $k = \frac{2\pi}{\lambda}$
  - ω : is the angular frequency $\omega = 2\pi f$
  - φ : is the phase shift
  - v : is the speed of wave $v = \frac{\lambda}{T}$
  - T : is the period $T = \frac{1}{f}$

http://hyperphysics.phy-astr.gsu.edu/hbase/waves/imgwav/wrel1.gif

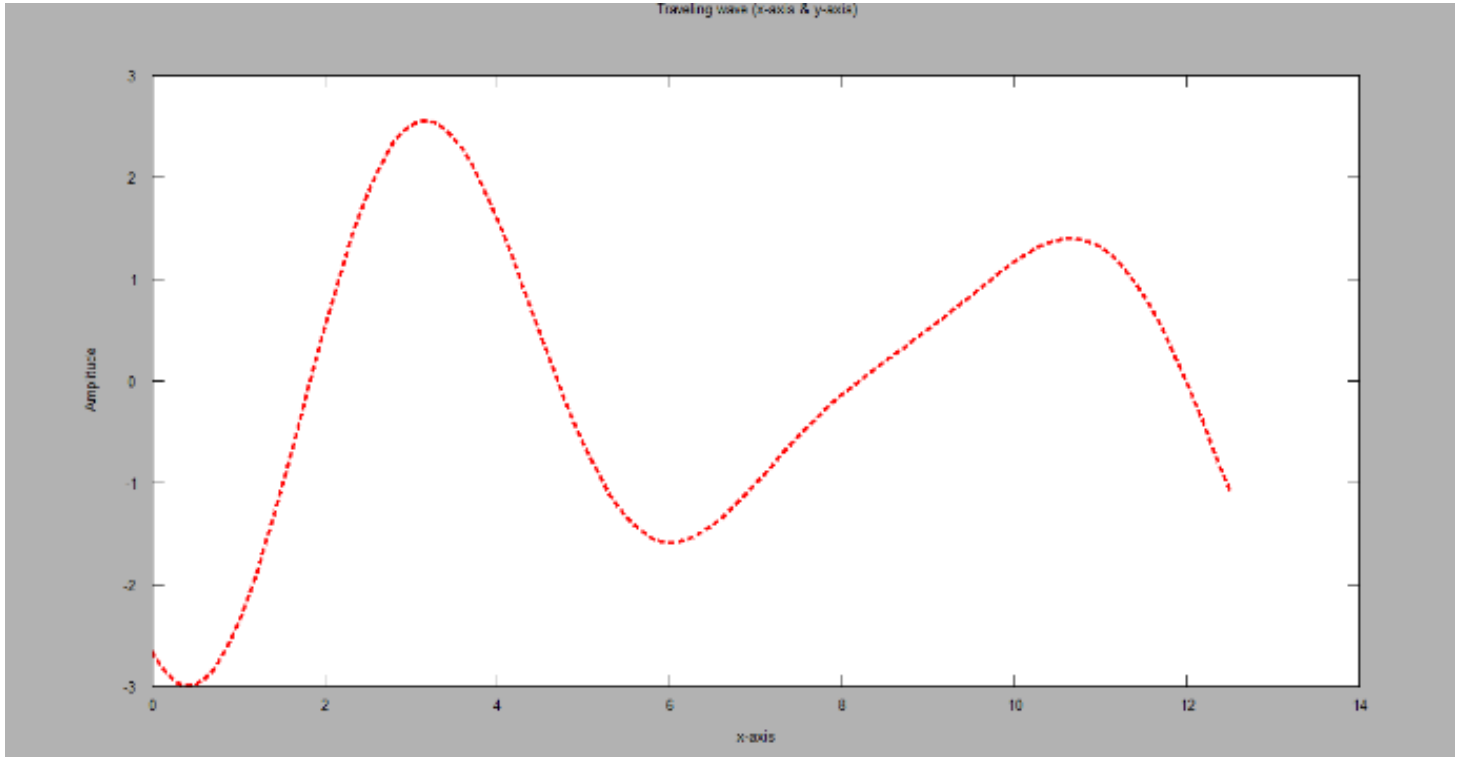
FreeMat Code

```
1   clc
2   close all
3   clear all
4   x= [0:0.1:4*pi];
5   kx=2;

6   w = 1;

7   for t=0:0.01:3
8     wave1= 3*sin(kx.*x - w.*t);
9     plot(x,wave1);
10    title('Traveling Wave (x-axis)')
11    xlabel('x-axis')
12    ylabel('Amplitude')
13    drawnow;
14  end
```



FreeMat Code (cont.)

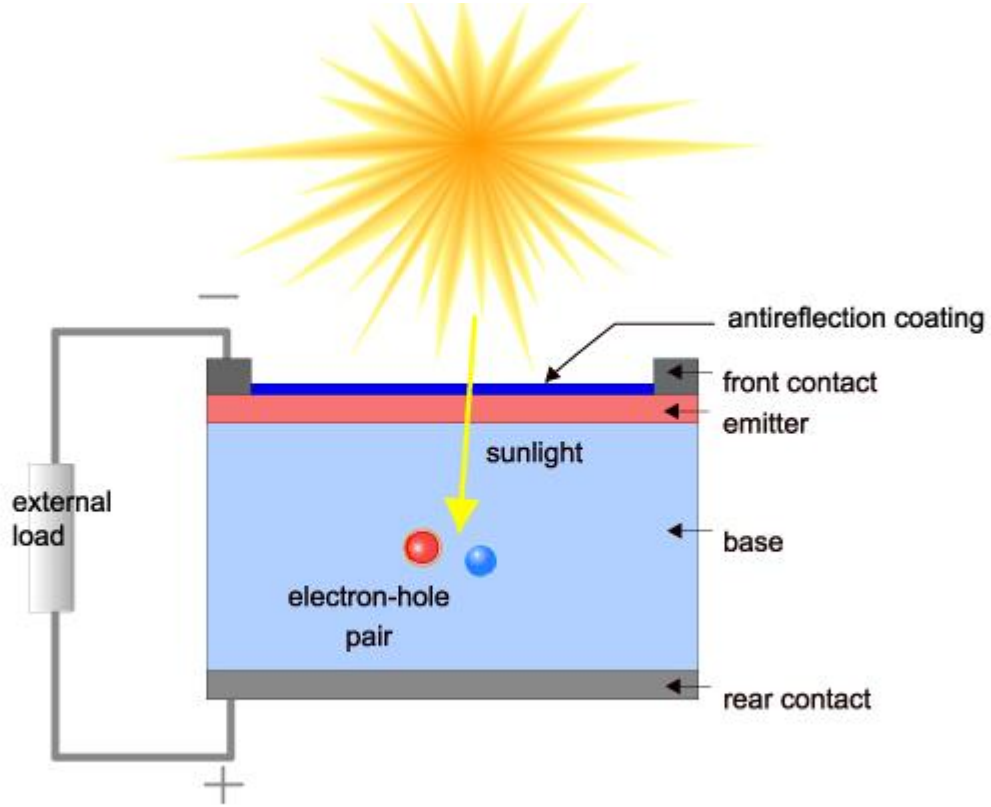
```
clc
close all
clear all
r = [0:0.1:4*pi];
x =  r;
y =  r;
kx1=sqrt(3)/2;
ky1=0.5;
kx2=0;
ky2=1;
w = 10;
for t=0:0.01:3
  wave1 = sin(kx1.*x + ky1.*y + w.*t);
  wave2 = 2*sin(kx2.*x + ky2.*y + w.*t);
  wave_tot=wave1+ wave2;
  title('Traveling wave(x-axis & y-axis)')
  xlabel('x-axis')
  ylabel('Amplitude')
  plot(r,wave_tot,':r','linewidth',3);
  drawnow;
end
```



Solar Cells

- **Solar cell Definition:**

  A solar cell is an electronic device which directly converts sunlight (visible light) into electricity.



Cross section of a solar cell.

http://pveducation.org/pvcdrom/solar-cell-operation/solar-cell-structure

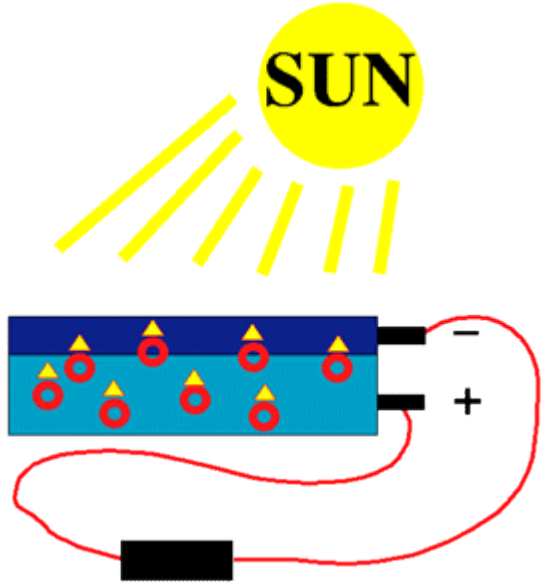
Solar Cells (cont.)

- **Solar cell process:**
  - Light shining on the solar cell produces both a current and a voltage to generate electric power.
  - This process requires firstly, a material in which the absorption of light raises an electron to a higher energy state.
  - Second, the movement of this higher energy electron from the solar cell into an external circuit (The electron then dissipates its energy in the external circuit and returns to the solar cell).
  - In practice nearly all photovoltaic energy conversion uses semiconductor materials in the form of a *p*-*n* junction.

http://pveducation.org/pvcdrom/solar-cell-operation/solar-cell-structure

Solar Cells (cont.)

- **Solar cell basic steps:**
  - The generation of light-generated carriers.
  - The collection of the light-generated carries to generate a current.
  - The generation of a large voltage across the solar cell.
  - The dissipation of power in the load and in parasitic resistances.



http://www.energyquest.ca.gov/story_old/images/chap15_pvcell.gif

http://pveducation.org/pvcdrom/solar-cell-operation/solar-cell-structure

Photosensor

- **Photosensor Definition:**
  - A photosensor is an electronic component that detects the presence of visible light, infrared transimission (IR), and/or ultraviolet (UV) energy.
  - Most photosensors consist of semiconductor having a property called photoconductivity , in which the electrical conductance varies depending on the intensity of radiation striking the material.

http://whatis.techtarget.com/definition/photosensor

Assignment !

- A very brief report on the types of the **photosensors** (Max. 2 pages).
- A FreeMat code for a two complete cycles traveling wave in x & y axis with the certain specification (phase shift 0, period 1.5 sec, speed of wave (x-direction) $\frac{4\pi}{15}\ m/s$, speed of wave (y-direction) $\frac{4\pi}{9} m/s$ and amplitude 5) ….. Draw the graph with a **green dotted line** with a **linewidth 4** and include **title**, **xlabel** and **ylabel**.
- **Due Date:2-Mar-15**

Thank you for your attention