Computer Aided Design (CAD)

Lecture 12

Matlab Applications

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Schedule (Updated 28-10)

Topics	Estimated Duration (# Lectures)
Introduction	1
Introduction to Matlab Environment	1
Matlab Programing (m-files) (1)	5
Modeling using Matlab Simulink Tool (1)	3
Midterm	7^{th} Week
Communication Systems Simulation (Applications)	3 **(2/3)**
Introduction to FPGA + Review on Digital Logic/Circuits	2
VHDL Modeling Language	4
VHDL Application	2
~~Introduction to OPNET Network Simulator~~ (Projects)	2
Course Closeout / Feedback/ project (s) Delivery	1

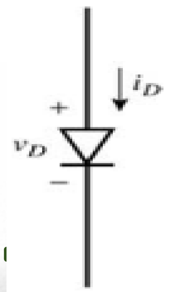
Application (1)

- Modeling of Electronic Devices (Example: Modeling of the I-V Characteristics of Diode)

Current Through a Diode The current flowing through the semiconductor diode shown in Figure is given by the equation

$$i_D = I_0\left(e^{\frac{qv_D}{kT}} - 1\right)$$

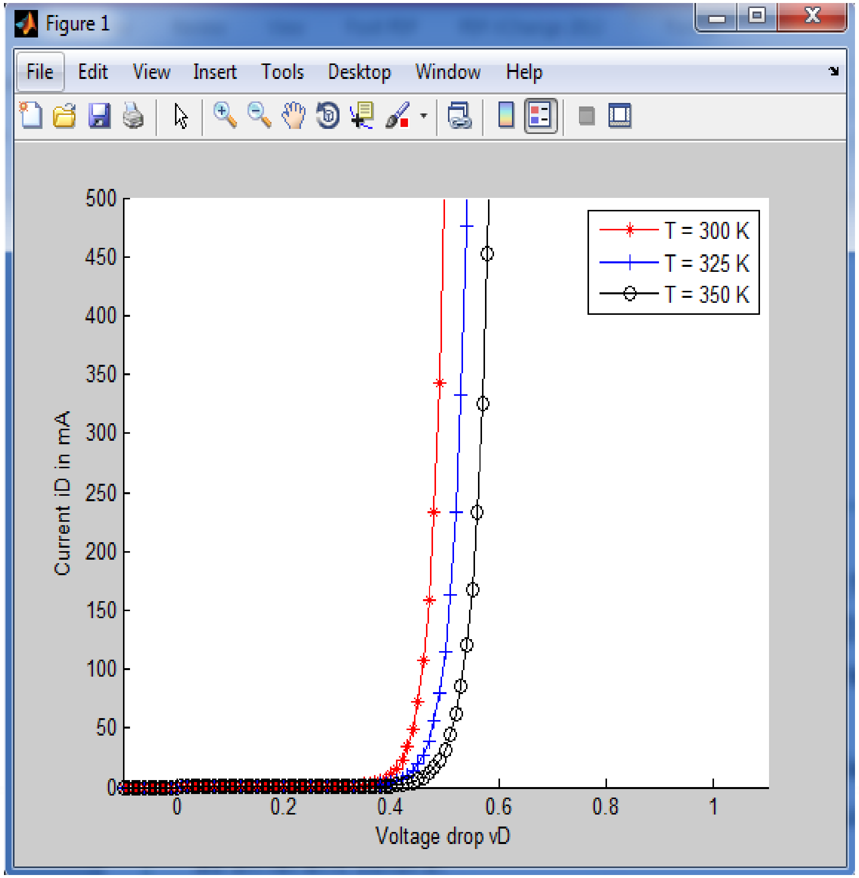
where i_D = the voltage across the diode, in volts
v_D = the current flow through the diode, in amps
I_0 = the leakage current of the diode, in amps
q = the charge on an electron, 1.602×10^{-19} coulombs
k = Boltzmann's constant, 1.38×10^{-23} joule/K
T = temperature, in kelvins (K)



A semiconductor diode.

Application (1)

- The leakage current I0 of the diode is 2.0 mA.
- Write a program to calculate the current flowing through this diode for all voltages from - 0.2 V to 1.5 V, in 0.01 V steps.
- Repeat this process for the following temperatures: 300, 325, and 350 °K
- Create a plot of the current as a function of applied voltage, with the curves for the three different temperatures appearing as different colors.



Application (1)

```
%% Initialization
close all; clear all; clc
   I0 = 2*(10^(-6));      % The leakage current of the diode, in amps
   q  = 1.602*(10^(-19));  % Electron Charge
   K  = 1.38*(10^(-23));  % Boltzmann's constant
%% Parameters
   T  = [300 325 350]; % Temperature in Kelvin
   vD = -0.1:0.01:1.2;   % voltage difference on the diode
   vT = K*T/q
%% Calculating Current Calculation for different voltages and
iD = zeros(length(T),length(vD));
for Tctr = 1: length(T)
    for Vctr = 1: length(vD)
        iD(Tctr,Vctr) = I0 *(exp((q*vD(Vctr))/(K*T(Tctr)))-1);
    end
end

%% Plotting
figure;hold on;
  plot(vD,iD(1,:),'-*r')
  plot(vD,iD(2,:),'-+b')
  plot(vD,iD(3,:),'-ok')

LEGEND1 = 'T = 300 K'; LEGEND2 = 'T = 325 K';LEGEND3 = 'T = 350 K';
legend(LEGEND1,LEGEND2,LEGEND3);
```

Application (2)
Polar Plot

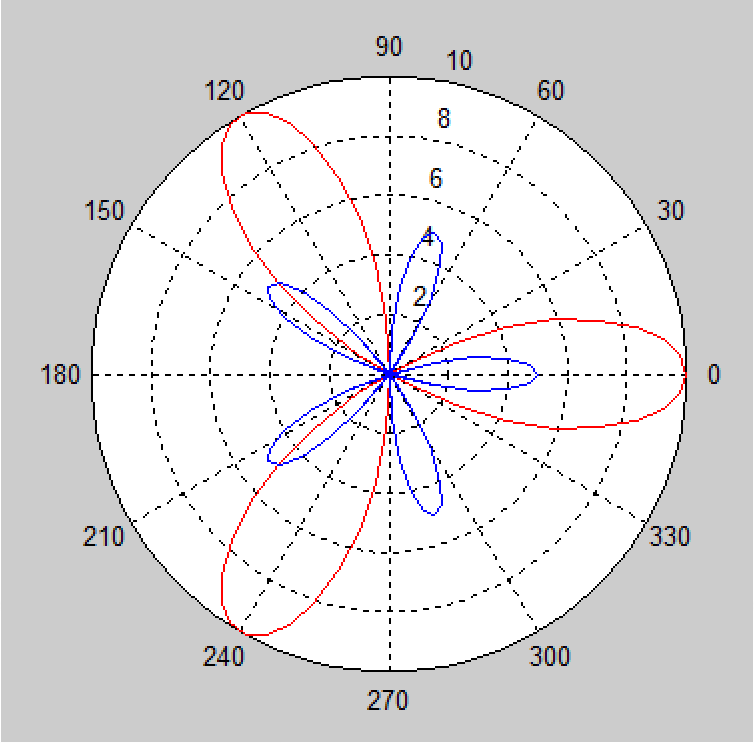
- Plot the functions of $r1 = 10\cos(3\theta)$ and $r2 = 5\cos(5\theta)$

  for $0 \le \theta \le 2\pi$ using a polar plot

Application (2)

```
%% Polar Plot
close all; clear all;clc
g1 = 10;
theta = 2*pi*(0:0.01:1);
r1 = g1*cos(3*theta);
polar (theta,r1,'r-')

hold on;
g2 = 5;
r2 = g2*cos(5*theta);
polar (theta,r2,'-b')
```



Application (3)
Loading data from a file for processing

Examples:

- **ECG Signals**
- **Audio Signals**