Computational Microelectronics

Assignment #3

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1. Matlab Code

Thickness : 5 nm

Material : SiC, Si_3N_4

```
N = 5;

%Thickness of two dielectric layers 5 nm
l = 5*(10^(-7));
% Vacuum Permittivity (F/cm)
E0 = 8.8541878176*(10^(-14));
% Relative Permittivity of SiC
E1 = 9.66;
% Relative Permittivity of Si3N4
E2 = 7.5;

A= zeros (N,N);
A(1,1) = 1;
A(N,N) = 1;
for i = 2:N-1
     if (i<(N-1)/2)
        A(i,i-1) = E1 ; A(i,i) = -2*E1; A(i,i+1) = E1;
    end
    if (i==(N-1)/2)
        A(i,i-1) = E1; A(i,i) = -E2-E1; A(i,i+1) = E2;
    end
    if (i>(N-1)/2)
        A(i,i-1) = E2 ; A(i,i) = -2*E2; A(i,i+1) = E2;
    end
end
b = zeros(N,1); b(N,1) = 1;
x=inv(A)*b;

% Capacitance per area of SiC
C1 = E1*E0/(l/2);
% Capacitance per area of Si3N4
C2 = E2*E0/(l/2);
```

➔ X = [0;0.2056;0.4704;0.7352;1]

2. Capacitance per area

- $C1 = 3.4213 \times 10^{-6}$ (F/cm^2)
- $C2 = 2.6563 \times 10^{-6}$ (F/cm^2)

3. Analytic Expression of Potential

$y = 0.436 X (x/(l/2))$ for $x<l/2$

$y = 0.564 X (x/(l/2)) – 0.128$ for $x>l/2$

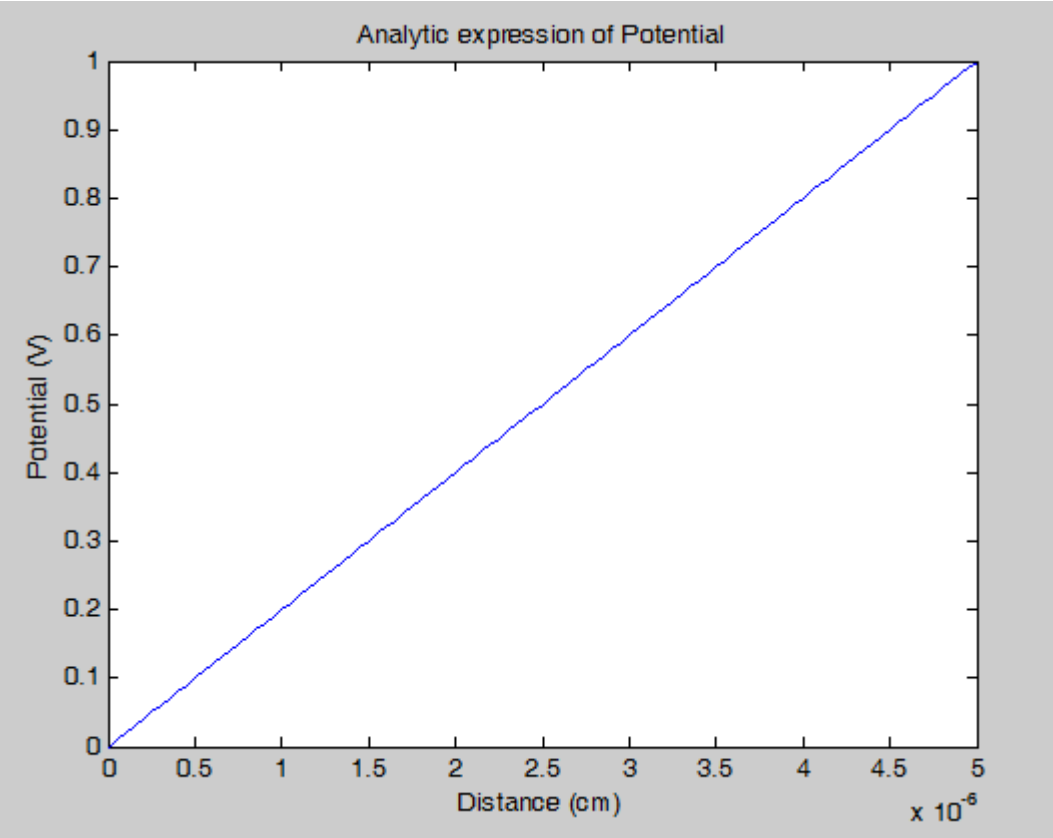
- Analytic value

  $y(0)= 0,$
  $y(l/4) = 0.218,$
  $y(l/2) = 0.436,$
  $y(3l/4) = 0.718,$
  $y(l) = 1$

- Results by Discretization

  $y(0) = 0,$
  $y(l/4) = 0.2056,$
  $y(l/2) = 0.4704,$
  $y(3l/4) = 0.7352,$
  $y(l) = 1$

- Analytic Expression




```
C1 = 3.43213*10^(-6);
C2 = 2.6563*10^(-6);
l = 5*10^(-6);
x = 0:l/100:l;
y = 0:l/100:l;

if (x<=l/2)
    y = 0.436.*(x/(l/2));
end
if (x>=l/2)
    y = 0.564.*(x/(l/2))-0.128;
end

figure
plot (x,y);
title('Analytic expression of Potential');
xlabel('Distance (cm)');
ylabel('Potential (V)');
```