# REPORT

## 1st Homework

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|---|---|
| Subject | Computational Microelectronics |
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| Due Date | 2018/09/09 - 8AM |

Below simulations is done using MATLAB.

This report shows the calculated potential ground which is dependent on the number of point (analysis resolution) and shows the error-rate between present point and steady-state point of 1000.

# <Assumption>

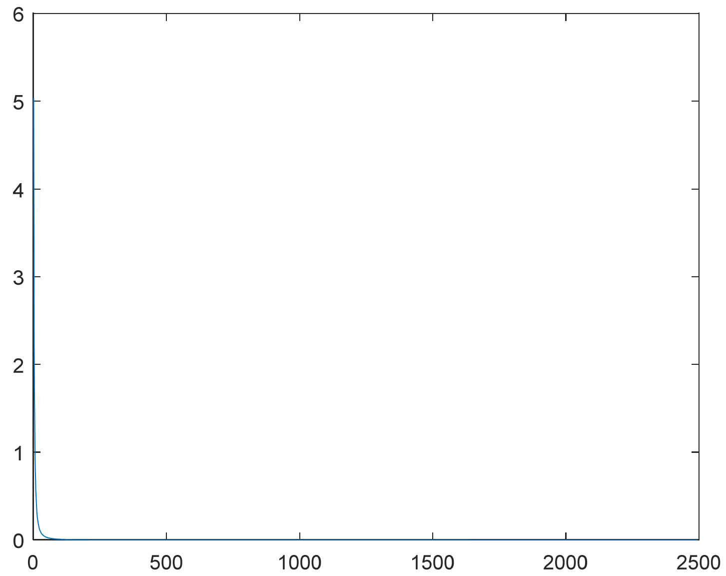
Potential well length is 5nm. The quantization point varies from 5 to 2500, and the $2500^{th}$ point can reach the steady-state of potential ground.

```matlab
clear all; clc;

m0 = 9.11*10^(-31); % electron mass(kg)
m = m0*0.19; % effective mass (kg)
a = 5 * 10^(-9); % potential well length(m)
h = 6.626 * 10^(-34); % Planck constant(J*s = kg*m/s)
h_b = h/(2*pi);
e_charge = 1.6*10^(-19);

E_eV = zeros(1000,1);
Error_rate = zeros(1000,1);
N_MIN=5;
N_MAX=50;

for N = N_MIN:N_MAX
    % 'N' are Variables for the accuracy test of point- in this case [5,50,500,5000]
A = zeros(N-2,N-2); % generate matrix
delx = a/(N-1); % Analysis resolution is determined
A(1,1) = -2; % the psi_1 is 0 by the boundary condition
A(1,2) = 1; % the psi_1 is 0 by the boundary condition
A(N-2,N-3) = 1; % the psi_N is 0 by the boundary condition
A(N-2,N-2) = (-2)*1;% the psi_N is 0 by the boundary condition
for i = 2:N-3
    A(i,i-1) = 1;
    A(i,i) = -2;
    A(i,i+1) = 1;
end
[V , D] = eig(A);
k_P_GND_D = min(D); % take non zero value of the each row
k_P_GND = max(k_P_GND_D); % configure the max value for absolute value of the minumum k
E_Joule = -h_b^2*k_P_GND/(2*m*delx^2); % The minimum Joule (Potential ground)
E_eV(N,1) = E_Joule/e_charge; % The minimum eV (Potential ground)
end
for N = 1:N_MAX-N_MIN+1
Error_rate(N,1) = 100*(1-(E_eV(N+N_MIN-1,1)/max(E_eV)));
% Catch an steady-state accuracy and calculate error rate
end
```

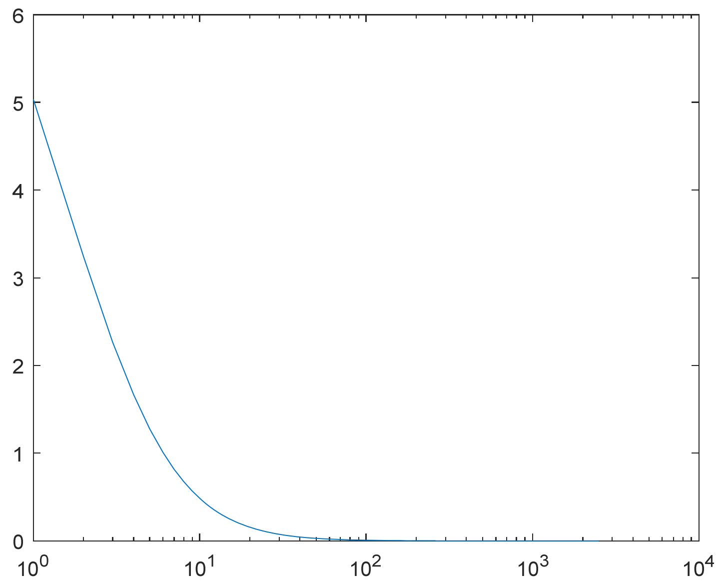
## <The potential ground at different point>

| # of point | 5 | 50 | 500 | 2500 |
|---|---|---|---|---|
| eV | 0.0753 | 0.0792 | 0.0793 | 0.0793 |

## <Error rate for confirmation of the steady-state>




<Error-rate>




<Error-rate (log scale x-axis)>

By this graph, the larger number of point is required for the accurate simulation result. The simulation accuracy is dependent on the number of point (resolution). So if we want to more accurate simulation in 1-dimensinal schrodinger equation.