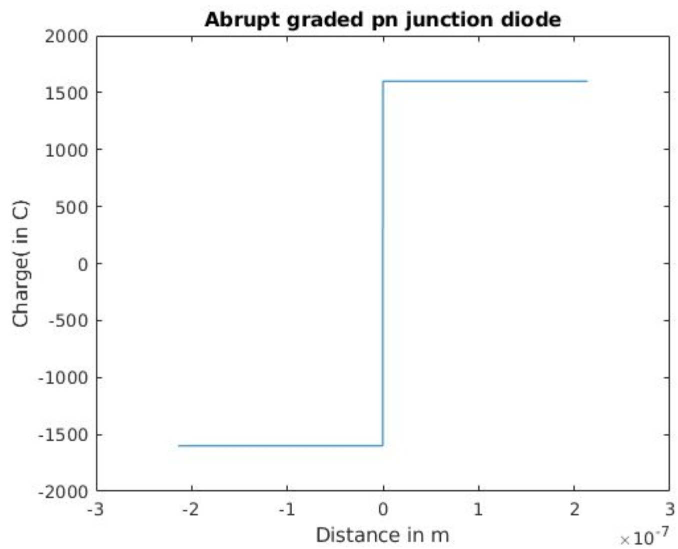
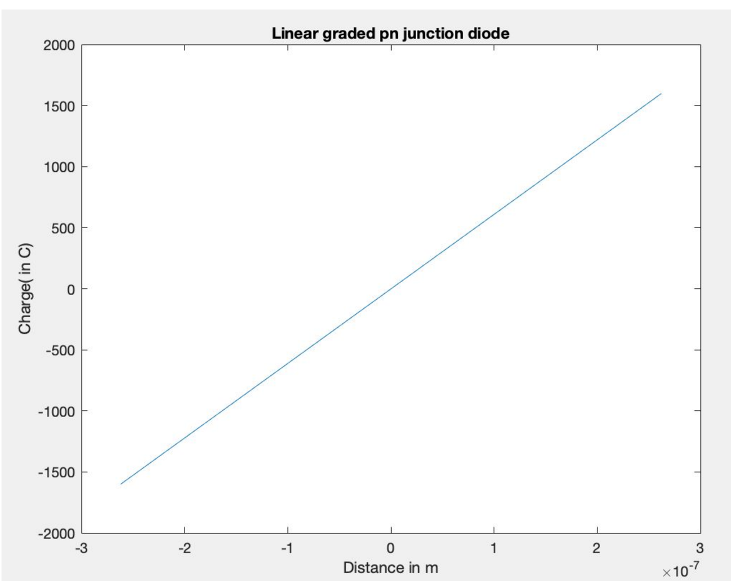
Assignment – 2

Question 1.
Solve the following for abrupt and linearly graded pn junction diode.



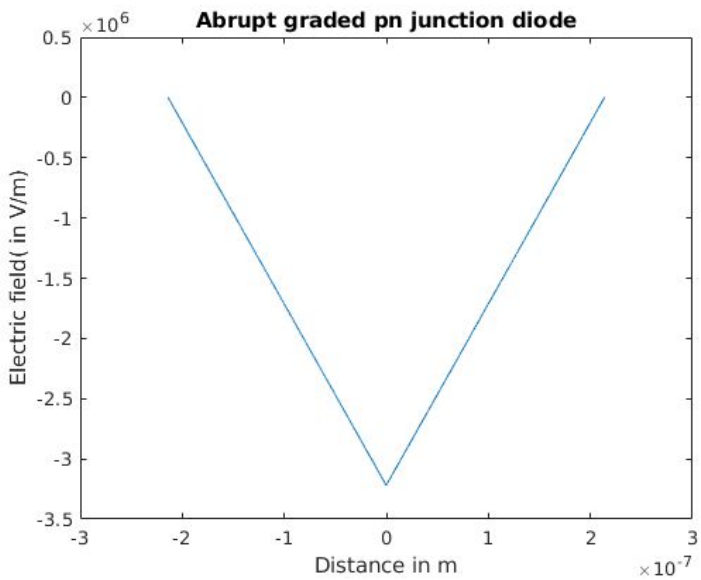


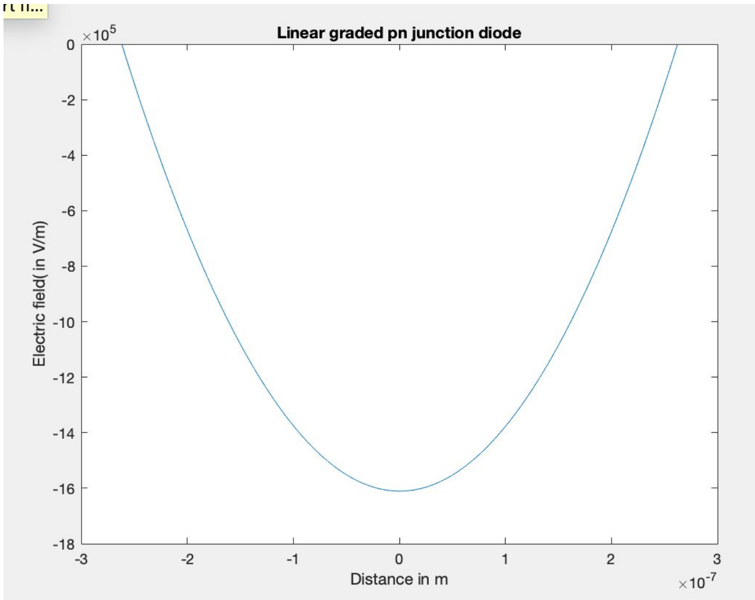
(a)Plot the Electric field profile by solving theGauss Law using numerical integration techniques such as Trapezoidal or Simpson's methods. Compare the result with the inbuilt MATLAB functions for integration. Check the accuracy of numerically integrated results by varying the grid spacing.

P- n diode
For abrupt doping
Xn = Xp = 2.1403e-07 m
No of points = 2000
Grid spacing : 2.1403e-10 m

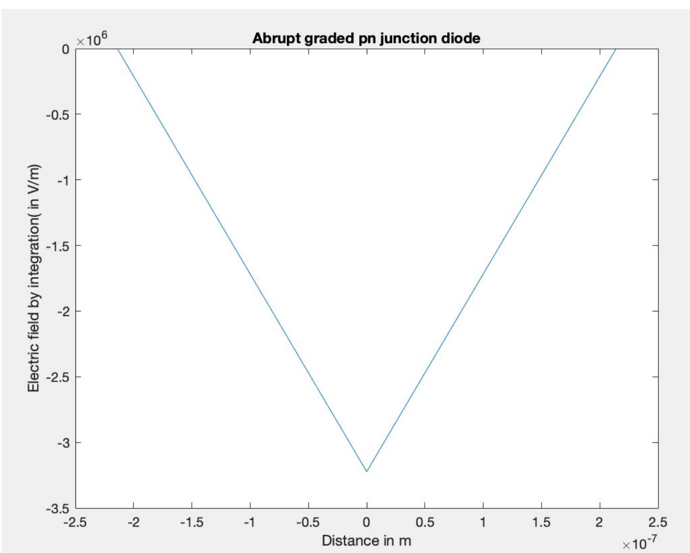
For linear doping
Xn = Xp = 2.6213e-07 m
No of points = 2000
Grid spacing : 2.6213e-10 m

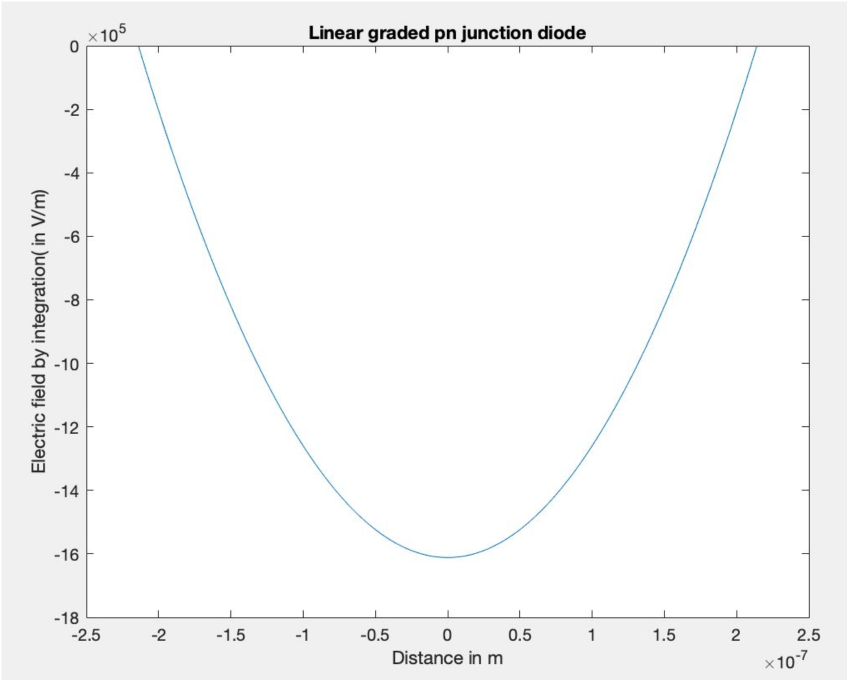
From **Simpson's methods**





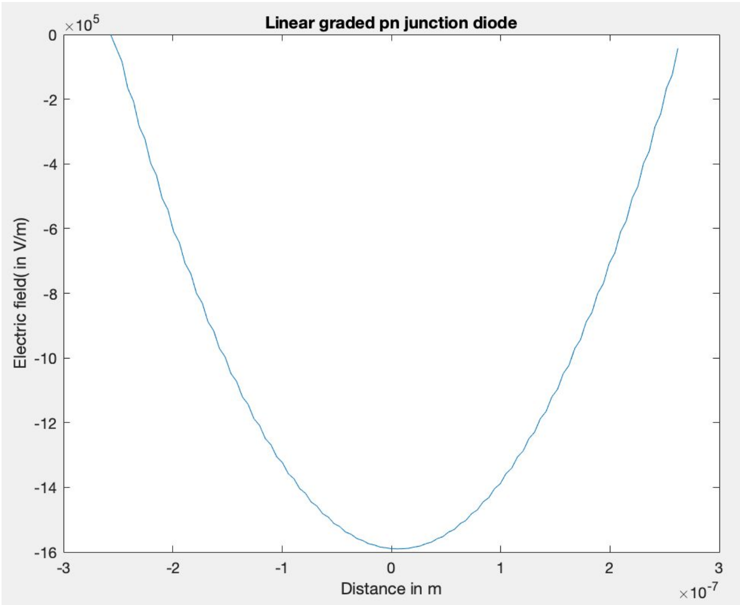
Matlab in built function:

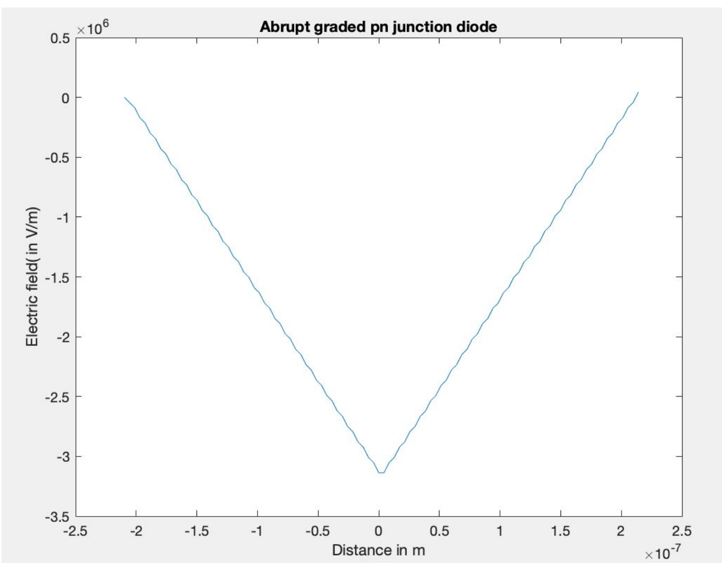




We can see that the simpson method give close answer as that of integration and the curve is also smooth for low grid spacing.

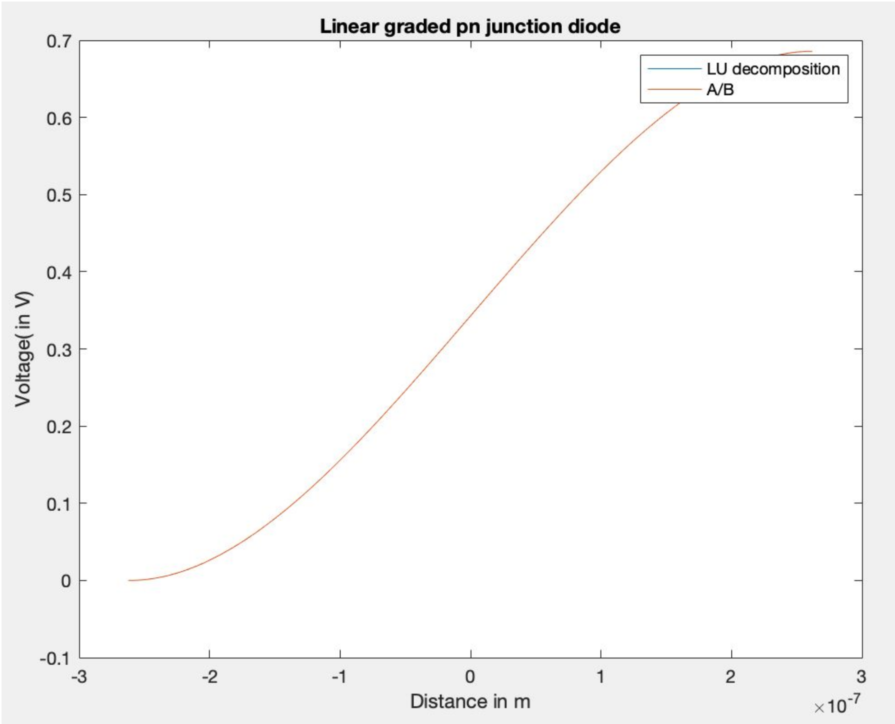
For abrupt channel
Xn = Xp = 2.1403e-07 m
No of points = 200
Grid spacing : 2.1403e-9 m
For linear doping
Xn = Xp = 2.6213e-07 m
No of points = 200
Grid spacing : 2.6213e-9 m

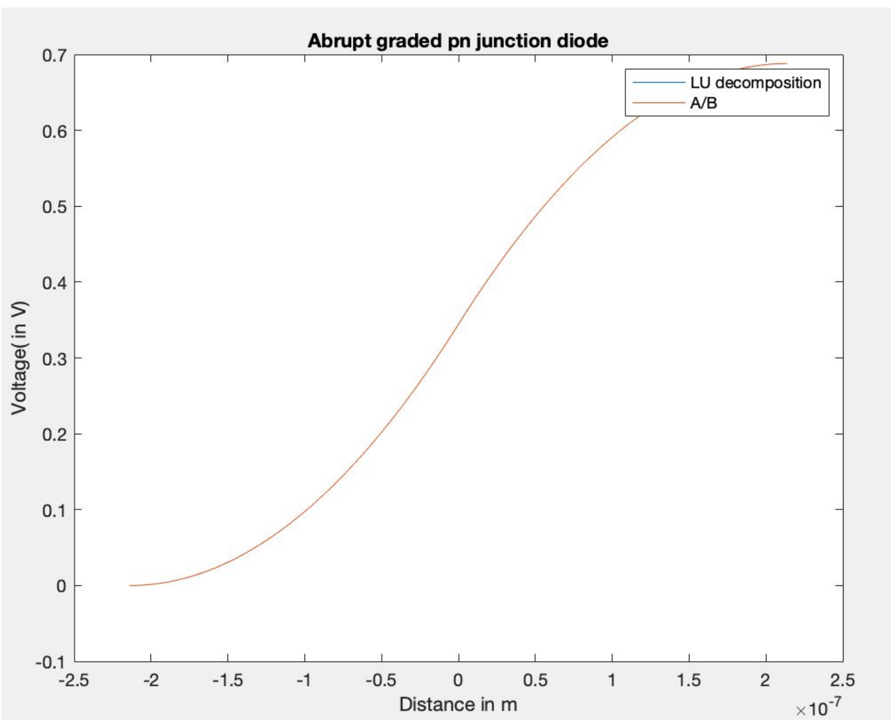




We can see that the graph is not smooth.

(b)Use central difference discretization scheme i.e.to solve the Poisson equation with depletion approximation. For this calculation first compute the L and U matrices numerically. Use these matrices to solve the system of linear equations $[A]_{n\times n}[V]_{n\times 1} = [b]_{n\times 1}$ using LU decomposition method and compare the result with inbuilt MATLAB operator $A\backslash b$.





We can see that the percentage error between the two is very less. The percentage error is of the order of 10^-12.thus both can be taken nearly constant. Their graph overlap each other

Question 2.

Consider a compensated semiconductor bar with doping concentrations N = 1e16 cm−3, $and\ N$ = DA 2e15 cm−3. Use Newton Raphson method to solve the charge neutrality equation for finding the fermi energy EF.

Ef comes our to be : 0.89657 eV