Exam in Numerical modelling of semiconductor devices

Name **Speciality**

1- We consider a semiconductor of silicon, write the Poisson's equation in each following case and determine (with explanation) if the calculation method to solve the equation is analytical or numerical method

1-1- The semiconductor material is intrinsic including only the free carriers of charge with concentrations n and p such as $n(x) = n_i + 10^{15}\, exp\left(-\frac{x}{L_n}\right)$, .. $p(x) = n_i + 10^{15}\, exp\left(-\frac{x}{L_p}\right)$

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1-2 The semiconductor material is intrinsic including only the free carriers of charge with concentrations n and p such as $n(x) = n(0)\, exp\left(\frac{q\psi(x)}{k_B T}\right)$, $p(x) = p(0)\, exp\left(-\frac{q\psi(x)}{k_B T}\right)$

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1-3 The semiconductor is doped simultaneously with uniform concentration of N_D donors and N_A acceptors and no free carriers exist

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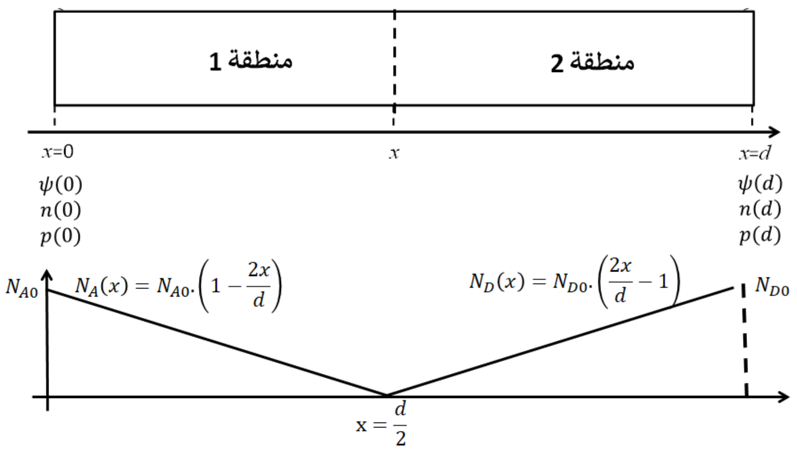

We consider the following sample -2
$k_B = 8625 \times 10^{-8}\ eV/K$

، $(h.c) \cong 1.2424\ eV.\mu m$ ،$q = 1.6 \times 10^{-19}$C
$m_t^* = 0.56\, m_0$ و $m_e^* = 1.08\, m_0$
$N_0 = 2.\left(\frac{2\pi m_0 k_B T_0}{h^2}\right)^{3/2} = 2.508 \times 10^{19} cm^{-3}$،
، $T = T_0 = 300°K$ ، $E_g = 1.12\ eV$
The sample is doped with the concentrations
. $N_{A0} = N_{D0} = 10^{17} cm^{-3}$
We consider thermal equilibrium at boundaries
-Write the boundary conditions applied on ψ , n and p, and calculate their values

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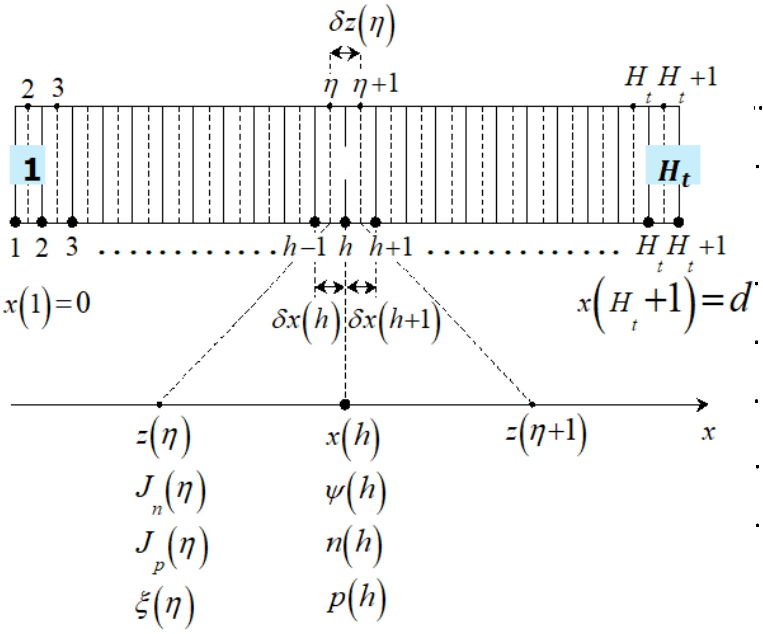
3- We consider the spatial discretization shown on the following schema, write the electron continuity equation in continuous formula taking into account only the diffusion current density, we give $g(x) = g_0 = 10^{20} cm^{-3} s^{-1}$, $U_R(x) = \frac{(n.p - n_i^2)}{(\tau_n(p+n_i) + \tau_p(n+n_i))}$



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4- Write the electron continuity equation in discretised formula and indicate the principal unknowns within it ....

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....Good luck