بسمه‌تعالی

فرمول‌های پایان‌ترم

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$$n_0 = N_c e^{-(E_c-E_f)/K_BT} \qquad p_0 = N_v e^{-(E_f-E_v)/K_BT}$$
$$N_c = 2\left[\frac{2\pi m_n^\star K_BT}{h^2}\right]^{\frac{3}{2}} \qquad N_v = 2\left[\frac{2\pi m_p^\star K_BT}{h^2}\right]^{\frac{3}{2}}$$
$$n_i = \sqrt{N_cN_v}e^{-E_g/2K_BT} \qquad E_i = \frac{(E_c+E_v)}{2} + \frac{3}{4}K_BTln(\frac{m_p^*}{m_n^*})$$
$$n_0 = n_i e^{(E_f-E_i)/K_BT} \qquad p_0 = n_i e^{(E_i-E_f)/K_BT}$$
$$\mu = \frac{v}{\varepsilon} \qquad \sigma = \frac{J}{\varepsilon}$$
$$\mu = q\frac{\tau}{m} \qquad D = \frac{L^2}{2\tau}$$
$$\frac{D}{\mu} = \frac{K_BT}{q} \qquad I = I_0e^{-\alpha t}$$
$$J_n = nq\mu_n\varepsilon + qD_n\frac{\partial n}{\partial x} \qquad J_p = pq\mu_p\varepsilon - qD_p\frac{\partial p}{\partial x}$$
$$g_{th} = \alpha_r n_0p_0 \qquad r = \alpha_r np$$
$$g = g_{th} + g_{opt} \qquad \tau = \frac{1}{\alpha_r(n_0+p_0)}$$
$$\frac{dn}{dt} = \frac{\partial n}{\partial t} - \frac{1}{q}\frac{\partial}{\partial x}J_n \qquad \frac{dp}{dt} = \frac{\partial p}{\partial t} + \frac{1}{q}\frac{\partial}{\partial x}J_p$$
$$n = n_i e^{(F_n-E_i)/K_BT} \qquad p = n_i e^{(E_i-F_p)/K_BT}$$
$$V_{bi} = \frac{KT}{q}ln\frac{N_aN_d}{n_i^2} \qquad W = \left[\frac{2\epsilon V_{bi}}{q}\left(\frac{1}{N_a}+\frac{1}{N_d}\right)\right]^{\frac{1}{2}}$$
$$\varepsilon_0 = -\frac{q}{\epsilon}N_dx_{n0} = -\frac{q}{\epsilon}N_ax_{p0} \qquad Q_+ = -Q_- = qAN_dx_{n0} = aAN_ax_{p0}$$
$$x_{p0} = \frac{WN_d}{N_a+N_d} \qquad x_{n0} = \frac{WN_a}{N_a+N_d}$$
$$\delta p_n = p_{n0}\left(e^{\frac{qV_a}{KT}}-1\right)e^{-(x-x_{n0})/L_p} \qquad \delta n_p = n_{p0}\left(e^{\frac{qV_a}{KT}}-1\right)e^{(x+x_{p0})/L_n}$$
$$L_p = \sqrt{D_p\tau_p} \qquad L_n = \sqrt{D_n\tau_n}$$
$$I = qA\left[\frac{D_p}{L_p}p_n + \frac{D_n}{L_n}n_p\right]\left(e^{\frac{qV_a}{KT}}-1\right) \qquad C_j = \epsilon\frac{A}{W}$$
$$\gamma = \left[1+\frac{L_p^nn_n\mu_n^p}{L_n^pp_p\mu_p^n}tanh\frac{W_b}{L_p^n}\right]^{-1} \qquad B = 1-\frac{W_b^2}{2D_p}$$
$$\beta = \frac{\alpha}{1-\alpha} = \frac{B\gamma}{1-B\gamma} \qquad \tau_t = \frac{W_b^2}{2D_p}$$
$$V_p = \frac{qa^2N_d}{2\epsilon} \qquad G_0 = -\frac{2Zq\mu_naN_d}{L}$$

$$I_E = Aq\frac{D_p}{L_p}\left\{p_{n0}\left(e^{\frac{qV_{EB}}{KT}}-1\right)coth\left(\frac{W}{L_p}\right) - p_{n0}\left(e^{\frac{qV_{CB}}{KT}}-1\right)csch\left(\frac{W}{L_p}\right)\right\}$$
$$I_C = Aq\frac{D_p}{L_p}\left\{p_{n0}\left(e^{\frac{qV_{EB}}{KT}}-1\right)csch\left(\frac{W}{L_p}\right) - p_{n0}\left(e^{\frac{qV_{CB}}{KT}}-1\right)ctgh\left(\frac{W}{L_p}\right)\right\}$$
$$I_D = G_0\left\{V_D - \frac{2}{3}(V_{bi}-V_p)\left[\left(\frac{V_D+V_{bi}-V_G}{V_{bi}-V_p}\right)^{3/2} - \left(\frac{V_{bi}-V_G}{V_{bi}-V_p}\right)^{3/2}\right]\right\}$$
$$I_{Dsat} = I_{D0}\left(1-\frac{V_G}{V_p}\right)^2, I_{D0} = G_0\left\{-V_p - \frac{2}{3}(V_{bi}-V_p)\left[1-\left(\frac{V_{bi}}{V_{bi}-V_p}\right)^{3/2}\right]\right\}$$
$$Si: E_g = 1.11eV, n_i = 1.5\times10^{10}cm^{-3} Si: m_n^* = 1.08m_0, m_p^* = 0.56m_0, \epsilon_r = 11.8$$
$$GaAs: E_g = 1.43eV, n_i = 10^6cm^{-3}, \epsilon_r = 13.2$$