Helpful constants for you:

$c = 3\ 10^{8}$ m/s
$e = 1.6\ 10^{-19}$ coulombs
$h = 6.63\ 10^{-34}$ J-s
$m = 9.1\ 10^{-31}$ kg
$k_B = 1.38\ 10^{-23}$ J/K
$k_BT/e = 0.029$ V at room temperature

Schroedinger Equation:

$$i\hbar\frac{\partial}{\partial t}\Psi(\vec{r},t)=-\frac{\hbar^2}{2m}\vec{\nabla}^2\Psi(\vec{r},t)=-\frac{\hbar^2}{2m}\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}+\frac{\partial^2}{\partial z^2}\right)\Psi(\vec{r},t)$$

Drift-Diffussion:

$$\frac{\partial\delta n}{\partial t}=D_n\frac{\partial^2\delta n}{\partial x^2}+\mu_n E\frac{\partial(\delta n)}{\partial x}-\frac{\delta n}{\tau}+G_n$$

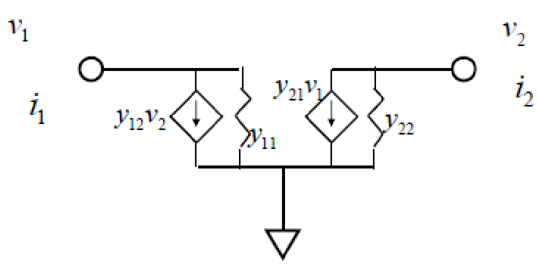
Fermi-Dirac:

$$P(E)=\frac{1}{e^{(E-E_f)/kT}+1}$$

Generalized π model:

Regardless of which configuration you use, the following π model applies:

$$\begin{pmatrix} i_1 \\ i_2 \end{pmatrix}=\begin{pmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{pmatrix}\begin{pmatrix} v_1 \\ v_2 \end{pmatrix}$$



Common source: 1=gate, 2=drain
Common gate: 1=source, 2=drain
Common drain: 1=gate, 2= source

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$$U = \frac{|y_{21} - y_{12}|^2}{4[\mathrm{Re}(y_{11}) \cdot \mathrm{Re}(y_{22}) - \mathrm{Re}(y_{12}) \cdot \mathrm{Re}(y_{21})]}$$

$$E_g(\mathrm{Al}_\xi \mathrm{Ga}_{1-\xi}\mathrm{As}) = \begin{cases} 1.424 + 1.247\xi & 0 \le \xi \le 0.45 \\ 1.900 + 0.125\xi + 0.143\xi^2 & \xi > 0.45 \end{cases} \quad \text{(1-88)}$$

$$\Delta E_v(\xi) = 0.55\xi \qquad \text{(in eV)} \quad \text{(1-89)}$$

$$\Delta E_c(\xi) = \begin{cases} (1.247 - 0.55)\xi & 0 \le \xi \le 0.45 \\ 0.476 + (0.125 - 0.55)\xi + 0.143\xi^2 & \xi > 0.45 \quad \text{(in eV)} \end{cases} \quad \text{(1-90)}$$

HETEROJUNCTION PARAMETERS AT ROOM TEMPERATURE

	$Al_{0.3}Ga_{0.7}As$/ GaAs	$Ga_{0.51}In_{0.49}P$/ GaAs	InP/ $In_{0.53}Ga_{0.47}As$	$In_{0.52}Al_{0.48}As$/ $In_{0.53}Ga_{0.47}A$	Si/ $Si_{0.8}Ge_{0.2}$
ΔE_g (eV)	0.37	Ordered: 0.43 Disordered: 0.46	0.60	0.71	Unstrained: 0.078 Strained: 0.165
ΔE_c (eV)	0.24	Ordered: 0.03 Disordered: 0.22	0.23	0.50	
ΔE_v (eV)	0.13	Ordered: 0.40 Disordered: 0.24	0.37	0.21	
s(cm/s)	103	2–200			

SEMICONDUCTOR MATERIAL PARAMETERS AT ROOM TEMPERATURE

	GaAs	$Al_{0.3}GaAs$	$Ga_{0.51}InP$	InP	$In_{0.53}GaAs$	$In_{0.52}AlAs$	Si
ϵ_r	13.1	~12.2	~11.9	12.6	~14.0	~12.5	11.9
N_c (cm^{-3})	4.7×10^{17}	—	—	5.8×10^{17}	$\sim 2.8 \times 10^{17}$	—	2.8×10^{19}
N_v (cm^{-3})	7.0×10^{18}	—	—	1.0×10^{19}	$\sim 6.0 \times 10^{18}$	—	1.04×10^{19}
n_i (cm^{-3})	1.79×10^{6}	—	—	1.05×10^{7}	6.31×10^{11}	—	1.45×10^{10}
E_g (eV)	1.424 (direct)	1.80 (direct)	1.86 (direct)	1.35 (direct)	0.75 (direct)	1.46 (direct)	1.12 (indirect)
$E_{\Gamma-L}$ (eV)	0.28	0.10	0.15	0.61	0.55	0.54	—
m_e^*/m_0	0.067	0.092	0.099	0.078	0.041	0.074	0.26
k_{th}(W/cm°C)	0.46	0.12	0.05	0.68	0.05	—	1.5
s (cm/s)	1×10^{6}	1×10^{6}	—	—	1×10^{3}	—	1×10^{3}
τ_n(s)	1×10^{-9}	—	—	—	—	—	1×10^{-6}
μ_n (cm^2/V-s)	4000	1400	1000	3200	7000	900	800
μ_p (cm^2/V-s)	250	130	75	150	300	180	400
v_{sat} (cm/s)	8×10^{6}	—	4.4×10^{6}	1.5×10^{7}	7×10^{6}	6×10^{6}	8×10^{6}

Note: When the parameter value of a material (such as $Al_{0.3}Ga_{0.7}As$) is obtained by linearly extrapolating between two extreme materials (such as AlAs and GaAs), an approximate sign is placed in front. All of the values are room-temperature values. Electron mobilities are taken at $N_d = 1 \times 20^{17}$ cm^{-3}. All mobility values are majority carrier values.

$$z' = z/R_o \quad y' = yR_o \quad h_{11}' = h_{11}/R_o;\; h_{12}' = h_{12};\; h_{21}' = h_{21};\; h_{22}' = h_{22}R_o$$

$s_{11} = \frac{(z_{11}'-1)(z_{22}'+1) - z_{12}' z_{21}'}{(z_{11}'+1)(z_{22}'+1) - z_{12}' z_{21}'}$	$y_{11}' = \frac{(1-s_{11})(1+s_{22}) + s_{12} s_{21}}{(1+s_{11})(1+s_{22}) - s_{12} s_{21}}$	$z_{11}' = \frac{(1+s_{11})(1-s_{22}) + s_{12} s_{21}}{(1-s_{11})(1-s_{22}) - s_{12} s_{21}}$	$h_{11}' = \frac{(1+s_{11})(1+s_{22}) - s_{12} s_{21}}{(1-s_{11})(1+s_{22}) + s_{12} s_{21}}$
$s_{12} = \frac{2 z_{12}'}{(z_{11}'+1)(z_{22}'+1) - z_{12}' z_{21}'}$	$y_{12}' = \frac{-2 s_{12}}{(1+s_{11})(1+s_{22}) - s_{12} s_{21}}$	$z_{12}' = \frac{2 s_{12}}{(1-s_{11})(1-s_{22}) - s_{12} s_{21}}$	$h_{12}' = \frac{2 s_{12}}{(1-s_{11})(1+s_{22}) + s_{12} s_{21}}$
$s_{21} = \frac{2 z_{21}'}{(z_{11}'+1)(z_{22}'+1) - z_{12}' z_{21}'}$	$y_{21}' = \frac{-2 s_{21}}{(1+s_{11})(1+s_{22}) - s_{12} s_{21}}$	$z_{21}' = \frac{2 s_{21}}{(1-s_{11})(1-s_{22}) - s_{12} s_{21}}$	$h_{21}' = \frac{2 s_{21}}{(1-s_{11})(1+s_{22}) + s_{12} s_{21}}$
$s_{22} = \frac{(z_{11}'+1)(z_{22}'-1) - z_{12}' z_{21}'}{(z_{11}'+1)(z_{22}'+1) - z_{12}' z_{21}'}$	$y_{22}' = \frac{(1+s_{11})(1-s_{22}) + s_{12} s_{21}}{(1+s_{11})(1+s_{22}) - s_{12} s_{21}}$	$z_{22}' = \frac{(1-s_{11})(1+s_{22}) + s_{12} s_{21}}{(1-s_{11})(1-s_{22}) - s_{12} s_{21}}$	$h_{22}' = \frac{(1-s_{11})(1-s_{22}) - s_{12} s_{21}}{(1-s_{11})(1+s_{22}) + s_{12} s_{21}}$
$s_{11} = \frac{(1-y_{11}')(1+y_{22}') + y_{12}' y_{21}'}{(1+y_{11}')(1+y_{22}') - y_{12}' y_{21}'}$	$y_{11} = \frac{z_{22}}{z_{11} z_{22} - z_{21} z_{12}}$	$z_{11} = \frac{y_{22}}{y_{11} y_{22} - y_{21} y_{12}}$	$h_{11} = \frac{z_{11} z_{22} - z_{21} z_{12}}{z_{22}}$
$s_{12} = \frac{-2 y_{12}'}{(1+y_{11}')(1+y_{22}') - y_{12}' y_{21}'}$	$y_{12} = \frac{-z_{12}}{z_{11} z_{22} - z_{21} z_{12}}$	$z_{12} = \frac{-y_{12}}{y_{11} y_{22} - y_{21} y_{12}}$	$h_{12} = \frac{z_{12}}{z_{22}}$
$s_{21} = \frac{-2 y_{21}'}{(1+y_{11}')(1+y_{22}') - y_{12}' y_{21}'}$	$y_{21} = \frac{-z_{21}}{z_{11} z_{22} - z_{21} z_{12}}$	$z_{21} = \frac{-y_{21}}{y_{11} y_{22} - y_{21} y_{12}}$	$h_{21} = -\frac{z_{21}}{z_{22}}$
$s_{22} = \frac{(1+y_{11}')(1-y_{22}') + y_{12}' y_{21}'}{(1+y_{11}')(1+y_{22}') - y_{12}' y_{21}'}$	$y_{22} = \frac{z_{11}}{z_{11} z_{22} - z_{21} z_{12}}$	$z_{22} = \frac{y_{11}}{y_{11} y_{22} - y_{21} y_{12}}$	$h_{22} = \frac{1}{z_{22}}$
$s_{11} = \frac{(h_{11}'-1)(1+h_{22}') - h_{12}' h_{21}'}{(1+h_{11}')(1+h_{22}') - h_{12}' h_{21}'}$	$y_{11} = \frac{1}{h_{11}}$	$z_{11} = \frac{h_{11} h_{22} - h_{21} h_{12}}{h_{22}}$	$h_{11} = \frac{1}{y_{11}}$
$s_{12} = \frac{2 h_{12}'}{(1+h_{11}')(1+h_{22}') - h_{12}' h_{21}'}$	$y_{12} = -\frac{h_{12}}{h_{11}}$	$z_{12} = \frac{h_{12}}{h_{22}}$	$h_{12} = -\frac{y_{12}}{y_{11}}$
$s_{21} = \frac{-2 h_{21}'}{(1+h_{11}')(1+h_{22}') - h_{12}' h_{21}'}$	$y_{21} = \frac{h_{21}}{h_{11}}$	$z_{21} = -\frac{h_{21}}{h_{22}}$	$h_{21} = \frac{y_{21}}{y_{11}}$
$s_{22} = \frac{(1+h_{11}')(1-h_{22}') + h_{12}' h_{21}'}{(1+h_{11}')(1+h_{22}') - h_{12}' h_{21}'}$	$y_{22} = \frac{h_{11} h_{22} - h_{21} h_{12}}{h_{11}}$	$z_{22} = \frac{1}{h_{22}}$	$h_{22} = \frac{y_{11} y_{22} - y_{21} y_{12}}{y_{11}}$

FIGURE 4-17. Conversion table between the *s*-, *y*-, *z*-, and *h*-parameters.