From *Semiconductor Physics and Devices: Basic Principles* (4th Edition), Donald A. Neamen, McGraw Hill, 2012, ISBN 978-0-07-352958-5.

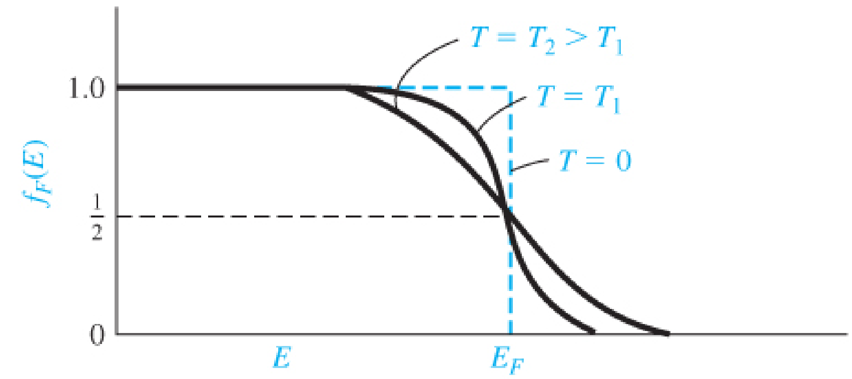
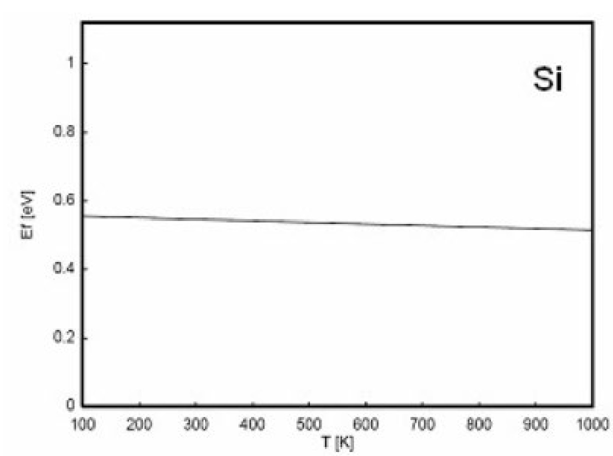
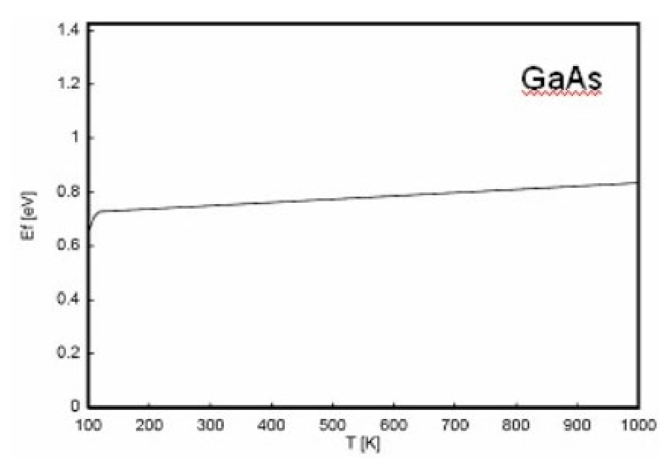


Figure 3.33 | The Fermi probability function versus energy for different temperatures.

- Note that $f_F(E)$ always passes through 0.5 at $E = E_F$.
- Note that $f_F(E)$ spreads out as temperature increases.

From
https://lampx.tugraz.at/~hadley/psd/weblectures/Ef_intrinsic/index.php#:~:text=The%20Fermi%20energy%20is%20in,kBT%20~%200.025%20eV.

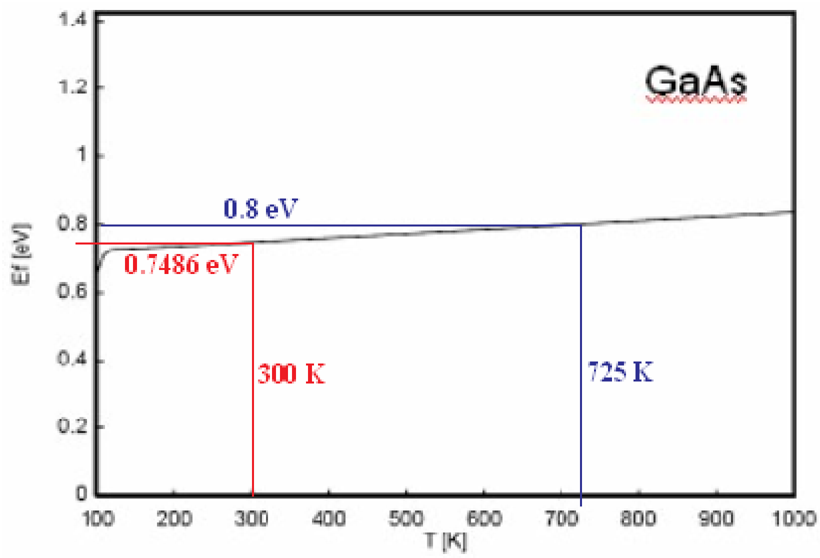




Properties	Si	Ge	GaAs
Bandgap E_g	1.12 eV	0.66 eV	1.424 eV
Effective density of states in conduction band (300 K) N_c	2.78×10^{25} m^{-3}	1.04×10^{25} m^{-3}	4.45×10^{23} m^{-3}
Effective density of states in valence band (300 K) N_v	9.84×10^{24} m^{-3}	6.0×10^{24} m^{-3}	7.72×10^{24} m^{-3}
Effective mass electrons m^*/m_0	$m_l^* = 0.98$ $m_t^* = 0.19$	$m_l^* = 1.64$ $m_t^* = 0.082$	$m^* = 0.067$
Effective mass holes m^*/m_0	$m_{lh}^* = 0.16$ $m_{hh}^* = 0.49$	$m_{lh}^* = 0.044$ $m_{hh}^* = 0.28$	$m_{lh}^* = 0.082$ $m_{hh}^* = 0.45$

Using MathCad

Example- Plot Fermi-Dirac probability function vs *E* (eV) at 300 K and 725 K for GaAs.



$kB\_eV := 8.617333 \cdot 10^{-5}$ eV/K

From graph, the Fermi energies for GaAs @ 300 K & 725 K are

$EF\_300 := 0.7486$ eV $\quad kB\_eV \cdot 300 = 0.025852$ eV

$EF\_725 := 0.8$ eV $\quad kB\_eV \cdot 725 = 0.062476$ eV

$n := 0..100$

$E_n := \frac{n}{100} \cdot 1.3 \qquad f\_F300_n := \frac{1}{1 + e^{\left(\frac{E_n - EF\_300}{kB\_eV \cdot 300}\right)}} \qquad f\_F725_n := \frac{1}{1 + e^{\left(\frac{E_n - EF\_725}{kB\_eV \cdot 725}\right)}}$