Formulae List

The maximum number of electrons in a shell (band) = $2N^2$

6.25×10^{18} electrons ➔1C of negative charge

Ohm's Law for ac:

$$\overline{V} = \overline{I}\overline{Z} \qquad \overline{I} = \frac{\overline{V}}{\overline{Z}} = \overline{V}\overline{Y} \qquad \overline{Z} = \frac{\overline{V}}{\overline{I}}$$

Capacitors:

Capacitive reactance, $X_C = \dfrac{1}{2\pi fC}$ in ohms

Inductors:

Inductive reactance, $X_L = 2\pi fL$ in ohms

AC Voltages and Currents:

$I_{rms} = I_p / \sqrt{2} = 0.7071\ I_p$ $\quad I_{p\text{-}p} = 2I_p$ $\quad I_{av} = 2I_p / \pi = 0.637 I_p$

$V_{rms} = V_p / \sqrt{2} = 0.7071\ V_p$ $\quad V_{p\text{-}p} = 2V_p$ $\quad V_{av} = 2V_p / \pi = 0.637 V_p$

AC Impedance/Admittance:

Series circuit,

$$\overline{Z}_R = R \qquad \overline{Z}_C = -jX_C = -j\frac{1}{\omega C} = \frac{1}{\omega C}\angle -90^o \qquad \overline{Z}_L = jX_L = j\omega L = \omega L \angle 90^o \qquad \omega = 2\pi f$$

$$\overline{Z} = \overline{Z}_1 + \overline{Z}_2 + \overline{Z}_3 + ... \qquad \phi = \angle\overline{Z} = \angle\overline{I} = \tan^{-1}\frac{X_{tot}}{R_{tot}}$$

Parallel circuit,

$$\overline{Y}_R = G \qquad \overline{Y}_C = jB_C = j\omega C = \omega C \angle 90^o \qquad \overline{Y}_L = -jB_L = -j\frac{1}{\omega L} = \frac{1}{\omega L}\angle -90^o \qquad \omega = 2\pi f$$

$$\overline{Y} = \overline{Y}_1 + \overline{Y}_2 + \overline{Y}_3 + ... \qquad \phi = \angle\overline{Y} = \angle\overline{V}_S = \tan^{-1}\frac{B_{tot}}{G_{tot}}$$

AC Power:

$$S = V_S I = I^2 Z \qquad P = V_S I \cos\phi = I^2 R \qquad Q = V_S I \sin\phi = I^2 X \qquad \cos\phi = \frac{P}{S}$$

Diodes:
Forward voltage drop is 0.7 V for silicon diode and 0.3 V for germanium diode

Zener impedance $Z_Z = \frac{\Delta V_Z}{\Delta I_Z}$

Half-Wave Rectifier:

$V_{out(p)} = V_{sec(p)} - 0.7V$ $V_{AVG} = \frac{V_{out(p)}}{\pi}$ $PIV = V_{sec(p)}$

Centre-Tapped Full-Wave Rectifier:

$V_{out(p)} = \frac{V_{sec(p)}}{2} - 0.7V$ $V_{AVG} = \frac{2V_{out(p)}}{\pi}$ $PIV = 2V_{out(p)} + 0.7V$

Full-Wave Bridge Rectifier:

$V_{out(p)} = V_{sec(p)} - 1.4\ V$ $V_{AVG} = \frac{2V_{out(p)}}{\pi}$ $PIV = V_{out(p)} + 0.7\ V$

Ripple Factor:

$r = \frac{V_{r(rms)}}{V_{DC}}$ where $V_{r(rms)} = \frac{V_{r(p-p)}}{2\sqrt{3}}$

Line Regulation = $\left(\frac{\Delta V_{OUT}}{\Delta V_{IN}}\right)100\%$ **Load Regulation** = $\left(\frac{V_{NL} - V_{FL}}{V_{FL}}\right)100\%$

Transistors:

$I_E = I_C + I_B$ $\beta_{DC} = \frac{I_C}{I_B}$ $\alpha_{DC} = \frac{I_C}{I_E}$ $\beta_{DC} = \frac{\alpha_{DC}}{1-\alpha_{DC}}$

$V_{BE} = 0.7V$ $V_{CC} = V_{CE} + I_C R_C$

$V_{BB} = V_{BE} + I_B R_B$ $V_{CE} = V_{CB} + V_{BE}$

Operational Amplifiers

Voltage Gain of Inverting Amplifier: $-\frac{R_f}{R_i}$

Voltage Gain of Non-inverting Amplifier: $1 + \frac{R_f}{R_i}$

Output voltage of summing amplifier:

$V_O = -\left(\frac{R_f}{R_1}V_1 + \frac{R_f}{R_2}V_2 + \frac{R_f}{R_3}V_3 + ... + \frac{R_f}{R_n}V_n\right)$ for "n" inputs

Threshold Voltages for comparator with positive feedback:

Upper Trigger Point (UTP) = $\frac{R_2}{R_1 + R_2}(+V_{O[max]})$

Lower Trigger Point (LTP) = $\frac{R_2}{R_1 + R_2}(-V_{O[max]})$