

Formula Sheet

General		
$A = L \cdot W$	$A = \pi r^2$	
$W = 0.5LI^2$	$W = 0.5CE^2$	
$\cos\theta = \frac{adj}{hyp}$	$\sin\theta = \frac{opp}{hyp}$	$\tan\theta = \frac{opp}{adj}$
$I = \frac{E}{R}$	$C = \frac{Q}{V}$	
$P = IE$	$P = I^2R$	$P = \frac{E^2}{R}$
$C = \frac{8.85 \times 10^{-12} \cdot K \cdot A}{d}$	$F_m = \frac{k \cdot I_1 \cdot I_2}{d^2}$	$F = \frac{k \cdot Q_1 \cdot Q_2}{d^2}$
$R = \frac{KL}{cma}$ Cu=10.4 Ω/milfoot, Al=17 Ω/milfoot (Imperial)		$R = \frac{\rho \ell}{A}$ Cu=1.72x10 ⁻⁸ Ω/m, Al=2.65x10 ⁻⁸ Ω/m (SI)
$R_{change} = R_{old} \cdot \alpha \cdot \Delta t$ (Cu=0.00393, Al=0.004)		
$\Phi = \frac{F_M}{R_M}$	$\beta = \frac{\Phi}{A}$	$\mu = \frac{\beta}{H}$
$H = \frac{F_M}{L}$		
$\tau = \frac{L}{R}$	$\tau = RC$	
$x_l = 2\pi fL$	$x_c = \frac{1}{2\pi fC}$	$Z = \sqrt{R^2 + X_{net}^2}$ (series only)
$Z = \frac{1}{\sqrt{\left(\frac{1}{R}\right)^2 + \left(\frac{1}{X_L} - \frac{1}{X_C}\right)^2}}$		
$E = Blv$	$L = \frac{N^2 \mu A}{\ell}$	$E = -L \frac{\Delta I}{\Delta t}$ and $E = -M \frac{\Delta I}{\Delta t}$
$e_{INST} = E_p \times \sin \theta$	$f = \frac{1}{p}$	
$f_r = \frac{1}{2\pi\sqrt{LC}}$	$L = \frac{\left(\frac{1}{2\pi fr}\right)^2}{C}$	$C = \frac{\left(\frac{1}{2\pi fr}\right)^2}{L}$
(VA) $S_{3\phi} = \sqrt{3} \cdot E_L \cdot I_L$ (omit $\sqrt{3}$ for 1 Φ)	(W) $P_{3\phi} = \sqrt{3} \cdot E_L \cdot I_L \cdot \cos \theta$ (omit $\sqrt{3}$ for 1 Φ)	(VAR) $Q_{3\phi} = \sqrt{3} \cdot E_L \cdot I_L \cdot \sin \theta$ (omit $\sqrt{3}$ for 1 Φ)
$pf = \cos\left(\tan^{-1}\left(1.732 \left(\frac{W2 - W1}{W2 + W1}\right)\right)\right)$	$IN = \sqrt{A^2 + B^2 + C^2 - (AB) - (BC) - (CA)}$	

Electronics		
1Φ half wave	1Φ full wave	
$E_{AVG} = E_{RMS} * \sqrt{2} * 0.318$	$E_{AVG} = E_{RMS} * \sqrt{2} * 0.637$	$E_{AVG} = E_P \frac{(1+\cos \alpha)}{\pi}$ (<i>full wave</i>)
$E_{AVG} = E_{RMS} \div 2.22$ (form factor)	$E_{AVG} = E_{RMS} \div 1.11$ (form factor)	$E_{AVG} = E_P \frac{(1+\cos \alpha)}{2\pi}$ (<i>half wave</i>)
3Φ half wave	3Φ full wave	
$E_{AVG} = E_{RMS} * \sqrt{2} * 0.827$	$E_{AVG} = E_{RMS} * \sqrt{2} * 0.955$	
$E_{AVG} = E_{RMS} * 1.17$ (form factor)	$E_{AVG} = E_{RMS} * 1.35$ (form factor)	

Machines		
$\frac{E_P}{E_S} = \frac{N_P}{N_S} = \frac{I_S}{I_P}$	$I_{SC} = \frac{I_{Secondary}}{\%IZ}$	
$HP = \frac{2\pi NT}{60 \cdot 550}$ and $HP = \frac{NT}{5252}$ (Imperial)	$P = \frac{2\pi NT}{60}$ (SI)	$T \propto E^2$ (in an induction machine)
$N \propto k\Phi E$	$T \propto k\Phi I$ (for a dc machine, for an AC machine, power factor of the rotor current must be taken into account)	
$N_{SLIP} = N_{SYNCH} - N_{ROTOR}$	$\%slip = \frac{N_S - N_r}{N_S} \times 100$	$N_{SYNCH} = \frac{N_{ROTOR}}{1 - \%Slip(decimal)}$
$\%V_{reg} = \frac{V_{NL} - V_{FL}}{V_{FL}} \times 100$	$\%N_{reg} = \frac{N_{NL} - N_{FL}}{N_{FL}} \times 100$	$f_{ROTOR} = \frac{N_{SLIP} \cdot P}{2 \cdot 60}$
$f = \frac{N \cdot P}{2 \cdot 60}$ (P is poles) Or $f = \frac{N \cdot P}{60}$ (P is pairs of poles)	$N = \frac{2 \cdot 60 f}{P}$ P is poles Or $N = \frac{60 f}{P}$ P is pairs of poles	