Phasors, Single and Three Phase Power

1. Notation for instanteous and phasor quantities:
   (a) Instaneous: $v(t) = V_{max} cos(\omega t + \theta_v)$
   (b) RMS Phasor quantity: $\overline{V} = \frac{V_{max}}{\sqrt{2}} \angle\theta_v$
2. Instaneous single phase power: $p(t) = \frac{1}{2} V_{max} I_{max} [cos(\theta_v - \theta_i) + cos(2\omega t + \theta_v + \theta_i)]$
3. Average single phase power: $P_{av} = \frac{1}{2} V_{max} I_{max} [cos(\theta_v - \theta_i)]$
4. Power Factor
   (a) Power factor angle (ϕ) = $\theta_v - \theta_i$
   (b) $-90^o \leq \phi \leq 90^o$
   (c) Power factor: pf = cos(ϕ), $0 \leq pf \leq 1$
   (d) Lagging Power Factor: $\phi > 0$
   (e) Leading Power Factor: $\phi < 0$
5. Three Phase Power
   (a) $\overline{S_{3\phi}} = 3\overline{V_\phi}\ \overline{I_\phi^*}$
   $|\overline{S_{3\phi}}| = \sqrt{3}\ |\overline{V_{ll}}|\ |\overline{I_l^*}|$
   (b) $P = 3|\overline{V_\phi}||\overline{I_\phi}|cos\phi$
   (c) $Q = 3|\overline{V_\phi}||\overline{I_\phi}|sin\phi$
   (d) $P = \sqrt{3}|\overline{V_{ll}}||\overline{I_l}|cos\phi$ (ϕ is the angle between **Phase** quantities!)
   (e) $Q = \sqrt{3}|\overline{V_{ll}}||\overline{I_l}|sin\phi$
   (f) Power dissipated in shunt resistor (Y connected):
   $P = \frac{3|\overline{V_\phi}|^2}{R} = \frac{|\overline{V_{ll}}|^2}{R}$
   (g) Reactive power to/from Y connected shunt reactance (capacitor or reactor)
   $Q = \frac{3|\overline{V_\phi}|^2}{X} = \frac{|\overline{V_{ll}}|^2}{X}$
6. $\overline{Z_\Delta} = 3\overline{Z_Y}$
7. The "a" operator:
   (a) $\overline{a}\ =\ 1\angle 120°$
   (b) $\overline{a^2}\ =\ 1\angle 240°$

(c) $\overline{a^3} = 1\angle 360°$

(d) $1 + \overline{a} + \overline{a^2} = 0$

(e) $1 - \overline{a} = \sqrt{3}\angle -30°$

(f) $1 - \overline{a^2} = \sqrt{3}\angle 30°$

(g) $\overline{a} - 1 = \sqrt{3}\angle +150°$

(h) $\overline{a^2} - 1 = \sqrt{3}\angle -150°$

(i) $\overline{a^2} - \overline{a} = \sqrt{3}\angle -90°$

(j) $\overline{a} - \overline{a^2} = \sqrt{3}\angle 90°$

(k) $\overline{a^2} + \overline{a} = 1\angle 180°$

(l) $\overline{I_b} = \overline{a^2}\,\overline{I_a}$

(m) $\overline{I_c} = \overline{a}\,\overline{I_a}$