Points to Remember

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1. Power: If current coming out of $+^{ve}$ terminal, then power **Supplied** else **Absorbed**
2. $\frac{dv}{dt} \Leftrightarrow j\omega V$
   $\int vdt \Leftrightarrow \frac{V}{j\omega}$
3. AC instantaneous power: $p(t) = v(t) \cdot i(t)$
4. AC average power:
   Voltage: $v(t) = V_m cos(\omega t + \theta_v)$
   Current: $i(t) = I_m cos(\omega t + \theta_i)$
   Average Power: $P = \frac{1}{2} V_m I_m cos(\theta_v - \theta_i)$
   A resistive load (R) absorbs power at all times, while a reactive load (L or C) absorbs zero average power (since $cos(\theta_v - \theta_i) = 0$)
5. Maximum Average Power Transfer Theorem: $Z_L = R_L + jX_L = R_{Th} + jX_{Th} = Z_{Th}^*$
   (* means conjugate)
   $$P_{max} = \frac{|V_{Th}|^2}{8R_{Th}}$$
   In a situation which the load is purely real, the condition for maximum power transfer is obtained by setting $X_L = 0$ and $R_L = \sqrt{R_{Th}^2 + X_{Th}^2} = |Z_{Th}|$
6. RMS value: $V_{rms} = \frac{V_m}{\sqrt{2}}$, $I_{rms} = \frac{I_m}{\sqrt{2}}$, $P_{avg/rms} = I_{rms}^2 R = \frac{V_{rms}^2}{R}$
7. Complex Power **S**: $P + jQ = V_{rms}(I_{rms})^* = |V_{rms}||I_{rms}|cos(\theta_v - \theta_i)$
   If $\theta_v - \theta_i < 0$, then leading else lagging
   $S_{NET} = S_1 + S_2 + S_3 + S_4 ...$
8. Apparent Power: $S = |\mathbf{S}| = |V_{rms}||I_{rms}| = \sqrt{P^2 + Q^2} = \frac{|V|^2}{|Z|}$
9. Real Power $P = \mathbf{Re(S)} = S\ cos(\theta_v - \theta_i)$
10. Reactive Power $Q = \mathbf{Im(S)} = S\ sin(\theta_v - \theta_i)$
    (if $Q == 0$, then unity power factor, if $Q < 0$ (for capacitive loads) then leading pf)
11. Power Factor: $\frac{P}{S} = cos(\theta_v - \theta_i)$ [It is also the cosine of the angle of the load impedance]
12. If (voltage phase - current phase) > 0, its lagging and vice-versa
13. The DC value of a source is equal to its average value over one period (so when you need DC voltage in an AC circuit, find the DC values of the source, treat the circuit elements as totally charged DC elements and solve)
14. P_{net} from superposition is $P_{1(RMS)} + P_{2(RMS)}$ independently
15. The unit for all forms of power is the watt (W), but this unit is generally reserved for active power. Apparent power is conventionally expressed in volt-amperes (VA) since it is the product of rms voltage and rms current. The unit for reactive power is volt-ampere reactive (VAR) .