EEE201
Circuit Analysis II

Ankara University

Faculty of Engineering

Electrical and Electronics Engineering Department

Sinusoidal Steady-State Power Calculations

EEE201 Circuit Analysis II

Lecture 6

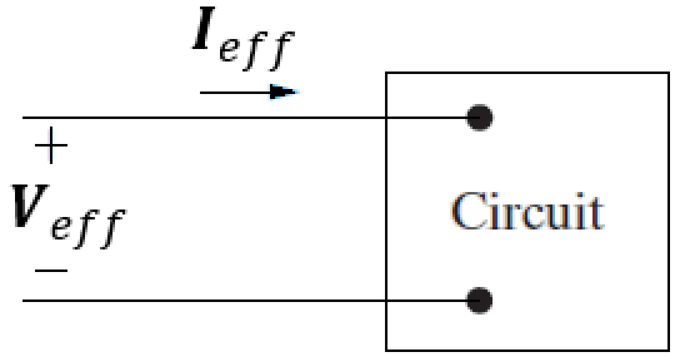
Agenda

- Alternate Forms for Complex Power
- Maximum Power Transfer

Alternate Forms for Complex Power

$$S = \frac{1}{2}\boldsymbol{V}\boldsymbol{I}^* = \frac{1}{2}V_m I_m \angle(\theta_v - \theta_i)$$

$$S = \boldsymbol{V}_{eff}\boldsymbol{I}_{eff}^* = V_{eff} I_{eff} \angle(\theta_v - \theta_i)$$



Alternate Forms for Complex Power

$$\boldsymbol{V}_{eff} = Z\boldsymbol{I}_{eff}$$

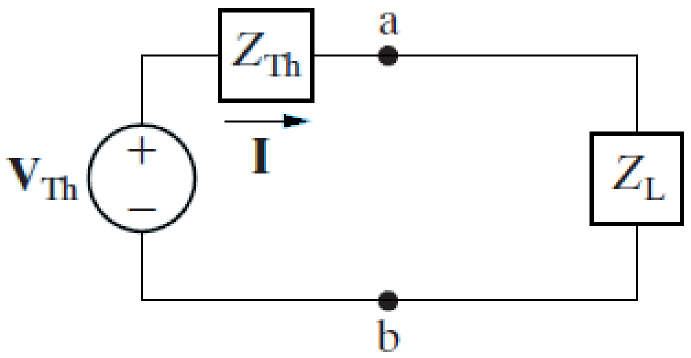
$$S = P + jQ$$

$$P = \left|\boldsymbol{I}_{eff}\right|^2 R = \frac{1}{2} I_m^2 R$$

$$Q = \left|\boldsymbol{I}_{eff}\right|^2 X = \frac{1}{2} I_m^2 X$$

Maximum Power Transfer

$$Z_L = Z_{Th}^*$$



If the Thevenin voltage is expressed in terms of its rms amplitude, the maximum average power delivered to the load is

$$P_{max} = \frac{1}{4}\frac{|\boldsymbol{V}_{Th}|^2}{R_L}$$

Maximum Power Transfer When Z is Restricted

R_L and X_L may be restricted to a limited range of values:

$$X_L \longrightarrow -X_{Th} \quad \text{and} \quad R_L \longrightarrow \sqrt{R_{Th}^2 + (X_L + X_{Th})^2}$$

The magnitude of Z_L can be varied but its phase angle cannot:

$$|Z_L| = |Z_{Th}|$$

Reference

- Electric Circuits, Tenth Edition, James W. Nilsson, Susan A. Riedel Pearson, 2015