Networks & Systems

- Ohm's Law: $V = R\,I$
- $R = \rho \dfrac{l}{A}$
- Capacitance $C = Q/V$
- Inductance $\psi = Li$
- Resistance $R_{eq} = R_1 + R_2 + \ldots + R_n$
- $\dfrac{1}{R_{eq}} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \ldots + \dfrac{1}{R_n}$
- Inductors in series $L_s = L_1 + L_2 + L_3 + \ldots + L_n$ and
- In parallel $\dfrac{1}{L_p} = \dfrac{1}{L_1} + \dfrac{1}{L_2} + \dfrac{1}{L_3} + \ldots + \dfrac{1}{L_n}$
- Capacitors in series $\dfrac{1}{C_s} = \dfrac{1}{C_1} + \dfrac{1}{C_2} + \dfrac{1}{C_3} + \ldots + \dfrac{1}{C_n}$
- Capacitors in parallel $C_p = C_1 + C_2 + C_3 + \ldots + C_n$
- Maximum power transfer $Z_L = Z_{th}^*$
- Δ to Y Conversion $R_A = \dfrac{R_{AB} \cdot R_{AC}}{R_{AB} + R_{AC} + R_{BC}}$,

  $R_B = \dfrac{R_{AB} \cdot R_{BC}}{R_{AB} + R_{AC} + R_{BC}}$,

  $R_C = \dfrac{R_{AC} \cdot R_{BC}}{R_{AB} + R_{AC} + R_{BC}}$
- Y to Δ Conversion

  $R_{AB} = \dfrac{\Delta}{R_C}$, $R_{AC} = \dfrac{\Delta}{R_B}$, $R_{BC} = \dfrac{\Delta}{R_A}$

  where, $\Delta = R_A R_B + R_B R_C + R_A R_C$
- Number of Links or Chords in a graph is

  $= b - (n-1)$

  = number of KVL = number of tie-set
- Number of Tree Branches or Twigs $= n - 1$

  = number of KCL = number of cut-set

- Number of tree in a graph: Det (AA^T),
  A – Reduced incidence matrix
- Rank of a graph $r = n - 1$
- Resonant frequency $\omega_0 = \dfrac{1}{\sqrt{LC}}$
- Quality factor(series resonance),

$$Q_0 = \frac{\omega_0}{\Delta\omega} = \frac{\omega_0}{\omega_1 - \omega_2} = \frac{1}{\omega_0 RC} = \frac{\omega_0 L}{R} = \frac{1}{R}\sqrt{L/C}$$

- Quality factor(parallel resonance),

$$Q_0 = \omega_0 RC = RC\frac{1}{\sqrt{LC}} = R\sqrt{C/L}$$

Parameter	Condition of reciprocity for Network	Condition of symmetry for Network
Z	$Z_{12} = Z_{21}$	$Z_{11} = Z_{22}$
y	$y_{12} = y_{21}$	$y_{11} = y_{22}$
h	$h_{12} = -h_{21}$	$h_{11}h_{22} - h_{12}h_{21} = 1$
ABCD	$AD - BC = 1$	$A = D$