Problem #16:

The circuit in figure (16) is to be used to match load with a source impedance to deliver maximum power to load within the passband of interest.

(a) Given that $R_s = 50\, \Omega$, $\omega_0 = 2\pi \times 1\, \text{GHz}$, $R_i = 20\, \Omega$, $Q$ of inductor is measured as 4 at resonant frequency, therefore, compute appropriate capacitor and inductor values to provide matching at resonant frequency, and find 3dB bandwidth of this matching filter.

(b) Verify the result by simulating the circuit in the SPICE.

Problem #17:

The circuit in figure (17) is to be used to down-convert the load to match with a source impedance to deliver maximum power to load within the passband of interest.
(a) Given that $R_i = 50\Omega$, $\omega_0 = 2\pi (1 \text{ GHz})$, $R_i = 200\Omega$, $Q$ of inductor is measured as 5 at resonant frequency, therefore, compute appropriate capacitor and inductor values to provide matching at resonant frequency, and find 3dB bandwidth of this matching filter.

(b) Verify the result by simulating the circuit in the SPICE.

**Problem #18:**

![C-Tapped Matching Filter](image1)

**Problem #19:**

Using the C-tapped matching topology, and assuming an ideal inductor, you are to design an up-converting network:

(a) Given that $R_i = 75\Omega$, $\omega_0 = 2\pi (2 \text{ GHz})$, $R_i = 25\Omega$, compute appropriate capacitor and inductor values to provide matching at resonant frequency.

(b) Verify the result by simulating the circuit in the SPICE.

![PI-Section Matching Filter](image2)
(a) Find $Z_m$ of the topology in figure 19.

(b) Let $\omega = \frac{1}{\sqrt{\frac{L}{C_A C_B}}} \sqrt{\frac{C_A C_B}{C_A + C_B}}$, find $Z_m$ in terms of resistive and, capacitive or inductive elements. Draw the equivalent $Z_m$, please label the elements with corresponding expressions.

(c) Let $\omega = \frac{1}{\sqrt{L C_A}}$, find $Z_m$ in terms of resistive and, capacitive or inductive elements. Draw the equivalent $Z_m$, please label the elements with corresponding expressions.

(d) Revisit section (c), what design condition must be met for $Z_m$ to be purely resistive?

(e) Given that as a designer you met the condition in section (d), thus, find out the circuit elements that matches load to source within the passband for two different sets of requirements:
   
   i  \quad R_s = 100\Omega, \quad \omega_0 = 2\pi \, (2 \text{ GHz}), \quad R_l = 50\Omega
   
   ii \quad R_s = 75\Omega, \quad \omega_0 = 2\pi \, (1 \text{ GHz}), \quad R_l = 150\Omega

(f) Verify the results found in section (e) with SPICE