Homework Policy: You are allowed to work with others on homework, BUT under 2 rules:
  o Rule 1: You write your own solutions.
  o Rule 2: You list all the other students with whom you collaborated on the assignment at
    the top of your homework.

Odd-numbered teams are doing L6.1 first (T3), and even-numbered teams are doing L6.2
first (T2). You will leave the mixer IC spot empty because we did not study mixers yet in
class. We will test this later.

ODD GROUPS DO THIS PART FIRST, then L6.3 (no need to do L6.2)

L6.1: Tuned transformer T3

Next we separately test the tuned transformer T3 with 23 windings on the primary and 6 on the
secondary.

What are the expected current, voltage and impedance transformation ratios?

\[ N_i = \frac{I_p}{I_s} = \] __________  \[ N_V = \frac{V_p}{V_s} = \] __________  \[ N_Z = \frac{Z_p}{Z_s} = \] __________

From class, what is the relationship between the magnetic flux in the core, current and voltage on
the secondary if the current is at a frequency \( f \)? (Pages 119-120 in the book).

\[ \Phi_m (I) = \]  \[ V(\Phi_m) = \]  \[ V (I) = \]  

How do you find the inductance of the primary?  \( L = \) ______________

You now move to the receiver circuit to transformer T3, which you will test on a breadboard
first. For this part of the lab, you will first wind the transformer on a core:
  - The core is a FT37-61 (unpainted)
  - The inductance constant is \( A_L = 66 \text{nH/turn}^2 \)
- Use a 40-cm long section of #26 insulated wire for the primary, and carefully wind 23 turns (figure below). Remove insulation from the ends of the leads.
- Use a 15-cm long thin colored wire for the 6 windings of the secondary.

When you have wound the transformer, check the following:
- That you have the correct core (no color).
- That all the wire ends are stripped of insulation. Try using a multimeter or putting solder on – if the solder does not stick easily, it means you did not get the insulation off.
- Short the secondary. What do you expect to measure on the primary?

I expect to see ______________________________

- Use the inductance meter to check your answer. Measured \( L = \) __________

Explain the function of C6 and calculate the value you expect.

_____________________________________________________________________________

_____________________________________________________________________________

C6 =

Is the value the same as in the block diagram? Why? – try to find the answer in the book.
Set the function generator to a 4.9-MHz sine wave with 0.5Vpp. Connect the tuned transformer to the function generator on the primary with a 47-pF capacitor in parallel and a 200-ohm resistor load on the secondary.

**EVEN GROUPS DO THIS PART FIRST, then L6.3 (no need to do L6.1)**

**L6.2: Tuned transformer T2**

Next we separately test the tuned transformer T2 with 1 winding on the primary and 20 on the secondary.

What are the expected current, voltage and impedance transformation ratios?

\[
N_I = I_p/I_s = \quad N_V = V_p/V_s = \quad N_Z = Z_p/Z_s =
\]

The transformer windings (left) and circuit for the tuned transformer tests (right).

From class, what is the relationship between the magnetic flux in the core, current and voltage on the secondary if the current is at a frequency \( f \)? (Pages 119-120 in the book).

\[
\Phi_m (I) = \quad V(\Phi_m) = \quad V (I) =
\]

How do you find the inductance of the primary?  \( L = \) __________

For this part of the lab, you will first wind the transformer on a core:
- The core is a FT37-61 (unpainted)
- The inductance constant is \( A_L = 66\text{nH/turn}^2 \)
- Use a 35-cm long section of #26 insulated wire for the secondary, and carefully wind 20 turns (figure below). Remove insulation from the ends of the leads.
- Use a 5-cm long thin colored wire for the single-turn primary.

When you have wound the transformer, check the following:
- That you have the correct core (no color).
- That all the wire ends are stripped of insulation. Try using a multimeter or putting solder on – if the solder does not stick easily, it means you did not get the insulation off.
- Short the primary. What do you expect to measure on the secondary?

I expect to see _____________________________________

- Use the inductance meter to check your answer. Measured \( L = \) _________________

Explain the function of C2 and calculate the value you expect.

_____________________________________________________________________________
_____________________________________________________________________________

C2 =

Now solder the transformer with the tuning capacitor into the circuit board with the receiver switch. Solder the potentiometer \( R_2=1\, \text{k}\Omega \) and the capacitor \( C_4=5\, \text{pF} \), and connect the output to a 1.5k\( \Omega \) resistor load that represents the mixer. Use the shortest cables possible when you do this. Set the function generator to a 7-MHz sine wave with 0.5Vpp, 50-ohm impedance and adjust the value of the tuning capacitor C2 for maximum voltage observed on the scope across the 1.5k\( \Omega \) load when the receiver switch is turned off.

Find the ratio of the power absorbed by the load to the available power. Express the loss in dB.

\[ P(\text{available}) = \] _____________

\[ P(\text{load}) = \] _________________

\[ \text{Loss (dB)} = \] _________________

**ODD + EVEN TEAMS DO THIS PART TOGETHER:**

**L6.3.** In this part, you will connect the transformer T3 to the IF filter you built previously and test the cascade. We first need to match the function generator (that will become the output of the
RF mixer) to the expected mixer output impedance of 3kΩ, see figure below. At the output (G1 holes on our board), connect a 1.5kΩ resistor and attach a scope across it with a 10:1 probe.

Set the function generator to 10Vpp. Adjust the frequency for maximum voltage observed on the scope. If $P_+$ is the available power from the 3-kΩ source, and $P$ is the power delivered to the 1.5-kΩ load resistor, calculate the loss:

\[
P_+ = \quad \text{__________________________}
\]

\[
P = \quad \text{__________________________}
\]

\[
L = 10 \log\left(\frac{P_+}{P}\right) = \quad \text{__________________________}
\]