For assignment 1, we needed to match impedance with a parallel, transformer based circuit. If we continue the Lab 1 example, which we did at 1 MHz (note your results will be different at 8 MHz) we had found the input impedance to be Zin = 323.771 – j872.113. To do a parallel match, need Yin = 1/Zin

$$Y_{in} = \frac{1}{Z_{in}} = \frac{1}{323.771 - j872.113} = 0.374m + j1.008m$$

As an aside in case you have forgotten how to take the inverse of a complex number - Either (1) multiply top and bottom by the complex conjugate (323.771+j872.113) or (2) convert to magnitude and angle (930.273 angle -69.633 degrees), take the inverse of the magnitude (1.075m) and the negative of the angle (+69.633 degrees) convert back to rectangular (0.374m+j1.008m) in agreement with the above.

$Y_{in}$ represents a parallel resistor (roughly equal to $r_\pi$) parallel to a parallel capacitor (roughly equal to $c_\pi$ gain x $c_\mu$).
$Y_{in} = 1/R_{amp} + j\omega C_{amp}$, or $R_{amp} = 2674\Omega$, and $C_{amp} = 160.0$ pF.

So, we will be matching 50Ω το 2674Ω, requiring a turns ratio of $\frac{N_2}{N_1} = \sqrt{\frac{2674}{50}} = 7.313$

Now to get the correct bandwidth, the resistance seen on the $N_2$ side of the transformer will be $R_{amp}$ of 2674 Ohms and the transformed resistance from the 50 Ohm source which will transform to exactly 2674 Ohms so the resistance is 2674/2 or $R_{total}$ =1337 Ohms.
Since BW = $1/R_{total}C_{total}$ and since the example shown happened to have 325 kHz bandwidth, let's do that here as well – of course, your bandwidth (and centre frequency) will be different. Thus, be 2π x 325 kHz = $1/R_{total}C_{total}$ and $C_{total}$ can be calculated to be 366 pF. Fortunately, this is bigger than $C_{amp}$ thus we need to add $C_{add}$ = 366-160=206pF.
Then, inductance L can be found from the required centre frequency knowing that

$$2\pi \times 1M = \frac{1}{\sqrt{LC_{total}}} \text{ or } L = \frac{1}{(2\pi \times 1M)^2 C_{total}} = 69.21\mu H$$

Now, the design is complete, except that we were supposed to take into account that all inductors, including the transformer have a Q of 50. Thus, knowing L, we can calculate the parallel resistance $R_p$ = QωL = 50 x 2π x 1M x 69.21 μH = 21.68k. Thus we are trying to match to $R_p \| R_{amp}$ = 2451Ω. Fortunately, this hasn't changed the numbers much, but that could be different in your case at 8 MHz. Now we need to go through the calculations again: $R_{total}$ = 2451/2=1226. $C_{total}$ = 399.4 pF, L = 63.42 uH. As a result the new $R_p$ is 19.92k.

For the output transformer, we replace the load resistor $R_L$ with 50 Ω, through a transformer with turns ratio $\frac{N_4}{N_3} = \sqrt{\frac{50}{R_L}}$ (in the original circuit, $R_L$ was 3k).

Total Gain from source to output is:

$A_v = \frac{1}{2}\frac{N_2}{N_1} g_m R_{LTotal} \cdot \frac{N_4}{N_3}$ where $R_{LTotal} = r_o \| R_L \| R_{3p}$. Here $R_{3p}$ is the parallel resistance of the $N_3$ side of the transformer. We are ignoring the inductance of the $N_4$ side. Note, if input voltage is defined not as the source, but directly at the $N_1$ side of the transformer, then the factor of ½ would be left out.

Bandwidth of the two circuits combined will be narrower and are given by the formula in the notes – result, new bandwidth is narrower by a factor of 0.6423, so new bandwidth is 325 x 0.6423 = 209 kHz.