1) An electrical two-port network is found to have the following transmission matrix.

\[
\begin{bmatrix}
V_1 \\
I_1
\end{bmatrix} = \begin{bmatrix}
2j & 1 \\
1 & -j
\end{bmatrix}
\begin{bmatrix}
V_2 \\
I_2
\end{bmatrix}
\]

a) Is this network reciprocal?

b) Find the coefficients of the impedance matrix, i.e., \( z_{11} \), etc., for this network.

c) Should your answer for the impedance matrix also be reciprocal? Why or why not? Is it reciprocal?

2) A really, really simple model for a junction transistor is provided below. Find the hybrid-\( h \) parameter of the two-port matrix for this model.

3) The impedance model for a magnetically coupled circuit has the following values: \( L_1 = 0.1 \) H, \( L_2 = 8.0 \) H, and \( M = 0.8 \) H. The series winding resistances are \( r_1 = 1.0 \) Ohms, and \( r_2 = 100.0 \) Ohms.

a) Use the methods shown in lecture to determine the frequency response.

b) What is the nominal frequency range for use of this device as a transformer? What is the approximate voltage ratio in this range?
4) The circuit below is a third-order, high pass filter.

Using the following component values gives the maximally flat, high-pass response with a corner frequency at $\omega_l = 1$ rad/sec: $C_1 = C_2 = C_3 = 1.00$ F, $R_1 = 4.94$ $\Omega$, $R_2 = 0.282$ $\Omega$, & $R_3 = 0.718$ $\Omega$.

(a) Plot the Bode diagram for this circuit if the roll-off is shifted to at 1 kHz.

(b) Use frequency scaling to find all component value for this circuit.

--------------  EXTRA CREDIT -- no particular due date  --------------

(c) If you are have a penchant for algebraic challenges, you might try to solve for the voltage transfer function. Start with the node equations, being careful to keep the current to the op-amp inputs at zero. Finding the answer on the web is fine, but is not adequate to get credit.