7. The linear time-invariant circuit of Fig. P12.7a, having a digraph shown in Fig. P12.7b, is in the sinusoidal steady state. From the digraph a tree is picked as shown in Fig. P12.7c.

(a) Write the fundamental cut-set matrix \( Q \).
(b) Calculate the cut-set admittance matrix \( Y_q \).
(c) Write the cut-set equations in the frequency domain in terms of the cut-set voltage and the current source:

\[
Y_q V_r = I_{eq}
\]

\( g_m = 2 \text{ S} \)
\( C_1 = 2 \text{ F} \)
\( C_2 = 1 \text{ F} \)
\( L_3 = 4 \text{ H} \)
\( L_4 = 3 \text{ H} \)
\( R_5 = 1 \text{ } \Omega \)
\( R_6 = 2 \text{ } \Omega \)
\( i_s = 3 \sin 2t \text{ A} \)

Figure P12.7a

Figure P12.7b

Figure P12.7c