Combining both cases we obtain the expressions:

\[
D_2 = (Q_2Q_0 + Q_1Q_0c + Q_2Q_1c' + Q_2Q_1Q_0c + Q_2Q_1Q_0c')x + Q_2x'
\]
\[
D_1 = (Q_1'Q_0c' + Q_1Q_0c + Q_1Q_0c' + Q_1Q_1Q_0'c)x + Q_1x'
\]
\[
D_0 = (Q_2Q_1Q_0' + Q_2Q_0'c + Q_1Q_0'c)x + Q_2x'
\]

The network is shown in Figure 8.32.

(c) the implementation of this circuit using a combination of T and D-type flip-flops is a combination of the cases presented in the previous two designs. Considering the two least significant state bits stored in T-type FFs and the most-significant in a D-type FF, the switching expressions are:

\[
D_2 = (Q_2Q_0 + Q_1Q_0c + Q_2Q_1c' + Q_2Q_1Q_0c + Q_2Q_1Q_0c')x + Q_2x'
\]
\[
T_1 = x((c \oplus Q_0') + Q_2Q_1)
\]
\[
T_0 = x(c + Q_2 + Q_1 + Q_0)(c' + Q_2' + Q_1')
\]

The network for this case is easily obtained from the other networks given for parts (a) and (b).

**Exercise 8.29**

To recognize the sequence \(x(t-3, t) = 0101\) or \(0110\) we need to distinguish among the following cases:

\[
S_1 : \ x(t-3, t-1) = 011
\]
\[
S_3 : \ x(t-3, t-1) = 010
\]
\[
S_2 : \ x(t-2, t-1) = 01
\]
\[
S_1 : \ \text{Not } \ S_3 \ \text{and } x(t-1) = 0
\]
\[
S_0 : \ \text{None of the above}
\]

The corresponding state table is

<table>
<thead>
<tr>
<th>PS</th>
<th>Input</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(x = 0)</td>
</tr>
<tr>
<td>(S_0)</td>
<td>(S_1, 0)</td>
</tr>
<tr>
<td>(S_1)</td>
<td>(S_1, 0)</td>
</tr>
<tr>
<td>(S_2)</td>
<td>(S_3, 0)</td>
</tr>
<tr>
<td>(S_3)</td>
<td>(S_1, 0)</td>
</tr>
<tr>
<td>(S_4)</td>
<td>(S_1, 1)</td>
</tr>
<tr>
<td></td>
<td>(\text{NS}, z)</td>
</tr>
</tbody>
</table>

Assigning to each state the binary value of its subindex the resulting state table is

<table>
<thead>
<tr>
<th>PS (Q_2Q_1Q_0)</th>
<th>Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>(000)</td>
<td>(001, 0)</td>
</tr>
<tr>
<td>(001)</td>
<td>(001, 0)</td>
</tr>
<tr>
<td>(010)</td>
<td>(011, 0)</td>
</tr>
<tr>
<td>(011)</td>
<td>(001, 0)</td>
</tr>
<tr>
<td>(100)</td>
<td>(001, 1)</td>
</tr>
<tr>
<td>(\text{NS}, z)</td>
<td></td>
</tr>
</tbody>
</table>
Figure 8.32: Networks for Exercise 8.28

Since the excitation function of a $JK$ flip-flop is

<table>
<thead>
<tr>
<th>PS</th>
<th>NS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>-1</td>
</tr>
<tr>
<td>1</td>
<td>-0</td>
</tr>
</tbody>
</table>

we determine the inputs $J_2, K_2, J_1, K_1, J_1$, and $K_1$ to be
Using K-maps we get the following switching expressions:

\[
J_2 = xQ_1Q_0'
\]

\[
K_2 = 1
\]

\[
J_1 = xQ_0
\]

\[
K_1 = xQ_0' + x'Q_0
\]

\[
J_0 = x'
\]

\[
K_0 = x
\]

The output expression is:

\[ z = x'Q_2 + xQ_1Q_0 \]

The sequential network is shown in Figure 8.33