1. \( G \) is ambiguous because there are two distinct parse trees (and two distinct leftmost derivations) of \( \text{if} \ c_1 \ \text{then} \ \text{if} \ c_1 \ \text{then} \ a_1 \ \text{else} \ a_1 \). The distinct leftmost derivations are

\[
S \Rightarrow \text{if} \ c_1 \ \text{then} \ B \ \Rightarrow \ \text{if} \ c_1 \ \text{then} \ \text{if} \ c_1 \ \text{then} \ B \ \text{else} \ S \Rightarrow \ \text{if} \ c_1 \ \text{then} \ c_1 \ \text{then} \ B \ \text{else} \ S
\]

and

\[
S \Rightarrow \ B \ \Rightarrow \ \text{if} \ c_1 \ \text{then} \ B \ \text{else} \ S \Rightarrow \ \text{if} \ c_1 \ \text{then} \ c_1 \ \text{then} \ B \ \text{else} \ S
\]

2. The stack has only 0’s or only 1’s on top of \( Z_0 \). When in \( q_0 \) and there are 1’s in the stack and a 1 is read, then we push the new 1 onto the stack; when a 0 is read we pop the 1 from the stack. We do the opposite when there are 0’s in the stack. When the stack contains only \( Z_0 \), we allow an \( \varepsilon \) -transition to \( q_1 \), the final state.

\[
P = \left\{ \{ q_0,q_1 \}, \{ 0,1 \}, \{ Z_0,0,1 \}, \delta, q_0, Z_0, \{ q_1 \} \right\}
\]

\[
\delta(q_0,\varepsilon,Z_0) = \{ (q_1,\varepsilon) \}
\]

\[
\delta(q_0,0,Z_0) = \{ (q_0,0Z_0) \}
\]

\[
\delta(q_0,0,0) = \{ (q_0,00) \}
\]

\[
\delta(q_0,0,1) = \{ (q_0,\varepsilon) \}
\]

\[
\delta(q_0,1,Z_0) = \{ (q_0,1Z_0) \}
\]

\[
\delta(q_0,1,1) = \{ (q_0,11) \}
\]

\[
\delta(q_0,1,0) = \{ (q_0,\varepsilon) \}
\]

We note that \( P \) accepts \( L \) by final state and by empty stack.

\[
( q_0,110001, Z_0 ) | -( q_0,10001,1Z_0 ) | -( q_0,0001,11Z_0 ) | -( q_0,001,1Z_0 ) | -( q_0,01, Z_0 ) | -( q_0,10Z_0 ) | -( q_0,\varepsilon,Z_0 ) | -( q_1,\varepsilon,\varepsilon )
\]