EXAM II ANSWERS

1) f(a, b, c, d) = \sum m(0, 4, 8, 11, 13, 15) + d(5, 9, 10, 12)
   f(a, b, c, d) = \overline{c} \overline{d} + ad

   1 2
   epi epi
   0 15

The 2-level AND-OR gate network TTL LS SSI chip usage:

We need
   2 inverters
   2 2-input AND gates
   1 2-input OR gate

   1 74LS04 w/ 6 inverters, 4 inverters unused
   1 74LS08 w/ 4 2-input AND gates, 2 gates unused
   1 74LS32 w/ 4 2-input OR gates, 3 gates unused

   3 chips used.  9 gates unused

2) The MUX implementation:

   \[
   \begin{array}{c}
   S2 \quad S1 \quad S0 \\
   \downarrow \quad \downarrow \quad \downarrow \\
   a \quad c \quad d \\
   \end{array}
   \]
3) The truth table and minterm lists:

<table>
<thead>
<tr>
<th>P1NSD2</th>
<th>P1NSD1</th>
<th>P1NSD0</th>
<th>P1N1</th>
<th>P1N0</th>
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The Minterm lists:

- \( P1N1 = \sum m(3,5,6,7) \)
- \( P1N0 = \sum m(1,2,4,7) \)

4) i) The implementation:

ii) The new rules with changes shown in bold italic:

- RD = 0 can be played anywhere. The player does not earn any points.

- If RD is not equal to zero, but N, it is playable on position k if:
  - position k is less than or equal to N
  AND
  - either (k-1) or (k+1) is less than or equal to N
  - for positions 0 and 3, the wraparound is not considered.