CS 210 Final Exam Study Guide

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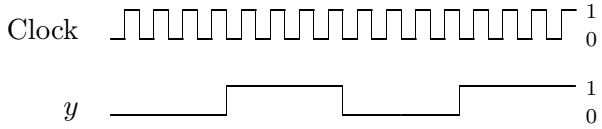
1. Consider the Boolean expression $e = (x + z)' + (x \oplus z) + xyz'$. Answer true or false for each of the following statements.
   (a) e is in inverted sum of products form.
   (b) $x'z$ is a prime implicant of e.
   (c) All prime implicants of e are two-dimensional.
   (d) There are no zero-dimensional implicants of e.
   (e) e is equivalent to $\prod(5, 6)$.
   (f) There is more than one minimal set of prime implicants which covers e.
   (g) xyz is an implicant of e.
   (h) $x'z$ is an implicant of e.
   (i) A minimum-literal inverted product of sums equivalent to e has two literals.
   (j) There are three prime implicants of e.
2. Consider the Boolean expression $e = (x + y')z + (z + y' + z)'$. Design four combinatorial circuits that implement e using
   (a) a two-level `NAND-NAND` circuit
   (b) a two-level `NOR-NOR` circuit
   (c) a 3-to-8 decoder
   (d) an 8-to-1 multiplexer
3. Consider a sequential circuit with one circuit output y that behaves like a clock pulse with 1/8 the frequency of the master clock pulse:



   Design this circuit using
   (a) T flip-flops
   (b) D flip-flops
   (c) JK flip-flops
   (d) RS flip-flops

   Hint: Notice that your state (i.e., the collective Q values of all your flip-flops) will transition once for every clock pulse. So, how many distinct states do you need? How many flip-flops are needed to represent those states?
4. Analyze the following sequential circuit. Give a minimized Boolean expression for each circuit output and flip-flop input, a state table, and a state diagram showing all states. Note that both flip-flops are JK flip-flops.