

**University of Waterloo**  
**Department of Electrical and Computer Engineering**  
**ECE 223 Digital Circuits and Systems**  
**Final Examination**  
**Winter 2000**

Duration 3 hours

Instructor: M. Sachdev

Date April 12, 2000

Name ..... Student ID .....									
1	2	3	4	5	6	7	8	9	Total

**Notes**

1. Attempt all problems.
2. If information appears to be missing make a reasonable assumption, state it and proceed.
3. Calculators are not needed and are not allowed.
4. No additional material is allowed.

Name:..... Student id:.....

**Problem 1**

**(A):** Convert following number from one radix to another [4]

$(127.094)_{10}$  to radix 5

**(B):** Write a 4-bit gray code. In what applications usage of gray code is desirable? [4]

Name:..... Student id:.....

**Problem 2**

**(A):** What is the difference between Mealy and Moore machines [4]

**(B):** Highlight two major differences between a Programmable Logic Array (PLA) and a Programmable Array Logic (PAL) devices [4]

Name:..... Student id:.....

**Problem 3**

Simplify the following Boolean function by means of Quine-McCluskey tabulation method [12]

$$P(A,B,C,D,E,F) = \Sigma(6, 9, 13, 18, 19, 25, 27, 29, 41, 45, 57, 61)$$

Name:.....

Student id:.....

**Problem 4**

Design a combinational circuit that converts a binary number of 4 bits (WXYZ) to a binary coded decimal (BCD) format. Show the logic level implementation. [12]

Name:.....

Student id:.....

**Problem 5**

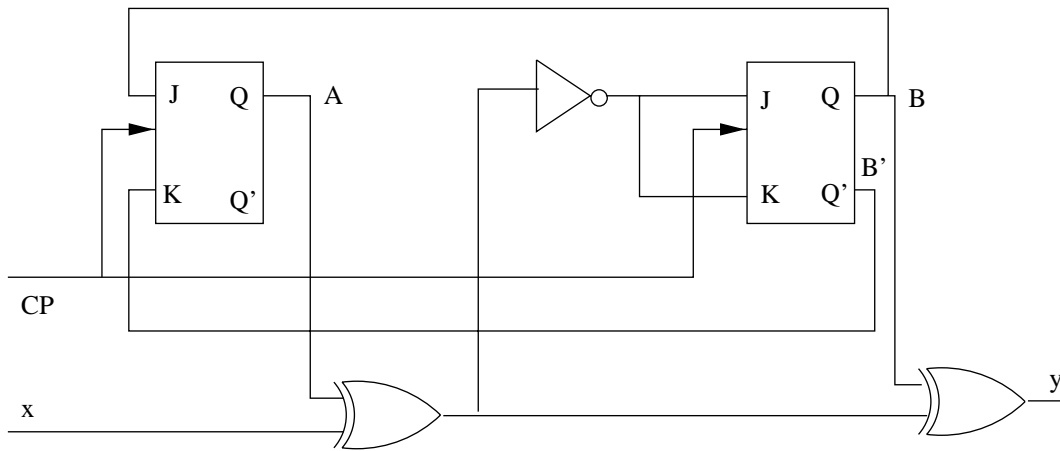
Give a logic diagram of a level sensitive, master-slave flip-flop. Why edge triggered flip-flops are generally preferred in digital designs? Give a logic level diagram for an edge triggered flip-flop. [12]

Name:.....

Student id:.....

**Problem 6**

A sequential circuit is shown in the figure. Derive the state table and state diagram of the circuit [12]



Name:..... Student id:.....

**Problem 7**

Design a 4-bit ripple counter with Toggle flip-flops. What is the disadvantage of a ripple counter? [12]



Name:.....

Student id:.....

**Problem 8**

Construct an ASM chart for a digital system that counts the number of people in a room. People enter the room from one door with a photocell that changes a signal  $x$  from 1 to 0 when the light is interrupted. They leave the room from a second door with a similar photocell with a signal  $y$ . Both  $x$  and  $y$  are synchronized with the clock but may stay on or off for more than one clock pulse period. The data processor subsystem consists of an up-down counter with a display of its contents. [12]

Name:.....

Student id:.....

**Problem 9**

Derive the transition table for the asynchronous sequential circuit shown in the figure. Determine the sequence on internal states  $Y_1Y_2$  for the following sequence of inputs,  $x_1x_2$  : 00, 10, 11, 01, 11, 10, 00 [12]

