

VALPARAISO UNIVERSITY
ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT

ECE 221

Examination #2

Fall 2002

Name: _____

Honor Code Pledge: _____

Signature: _____

This is an open-book, closed-notes examination to be performed by each student individually. Write your name on the line above before you start the exam, and then write out and sign the honor code after you have completed the exam. For each question show the development of your solutions and then place your final answer in the space provided.

Problem 1	/35
Problem 2	/40
Problem 3	/25
Total	/100

Question 1: Combinational Circuit Implementations (35 points)

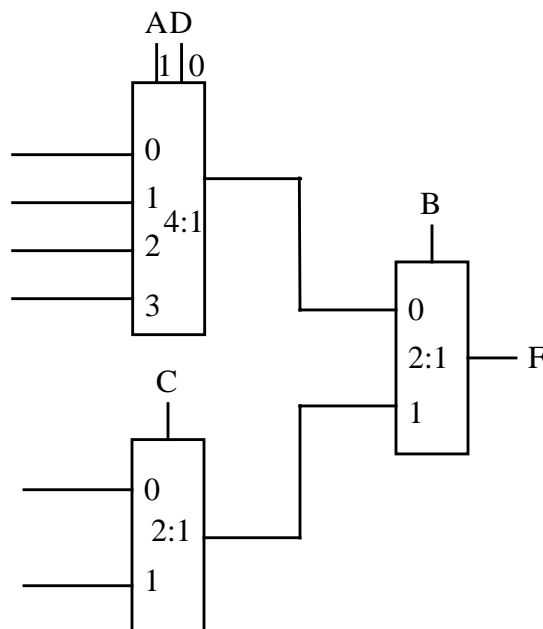
Given the following boolean expression

$$f(A, B, C, D) = \sum m(0, 1, 2, 3, 5, 6, 8, 10, 11, 13, 14)$$

Find the minimized boolean expressions and then complete the various implementations below.

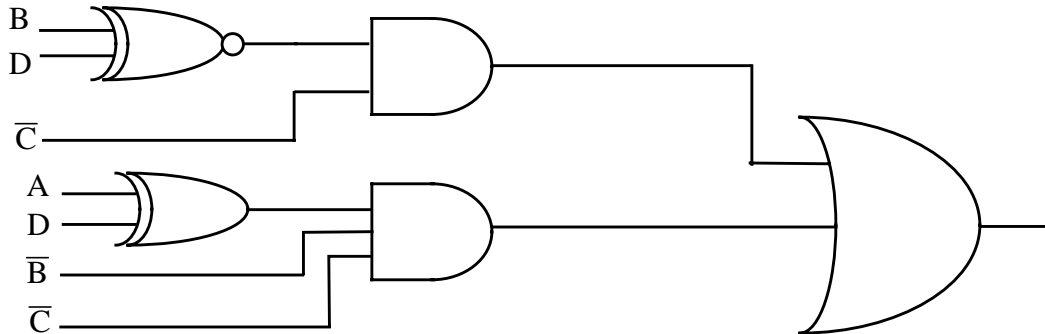
a) (8 points) Find the minimized boolean expressions in SOP and POS form.

b) (12 points) **Multiplexers.** Add the input values to the multiplexers below. Minimize the number of extra gates used (any type) and assume the variables (A,B,C,D) are available only in uncomplemented form.



Question 1: Combinational Circuit Implementations (cont.)

c) (7 points) **Exclusive OR:** Complete the design below by adding the minimum number of extra gates to implement the function. Assume the complements of the inputs are available and you can use gates with as many inputs as you need (ex: 3-input AND)



d) (8 points) **Universal Gates:** Implement the design using the minimum number of 2-input universal gates (NANDs and NORs). Assume the variables (A,B,C,D) are available only in uncomplemented form.

Question 2: Sequential Circuit Analysis (40 points)

Given the schematic on page 6, complete the sequential circuit analysis below.

a) (4 points) Given the circuit, answer the following questions:

1. How many states are there? _____ 2. Is the circuit a Mealy or a Moore machine? _____

b) (10 points) What are the next state and output expressions.

$Q_A^+ =$ _____

$Q_B^+ =$ _____

$Q_C^+ =$ _____

$Y =$ _____

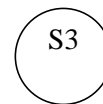
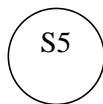
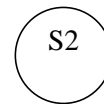
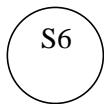
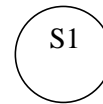
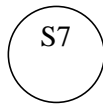
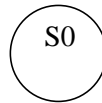
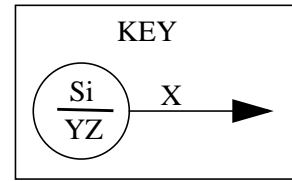
$Z =$ _____

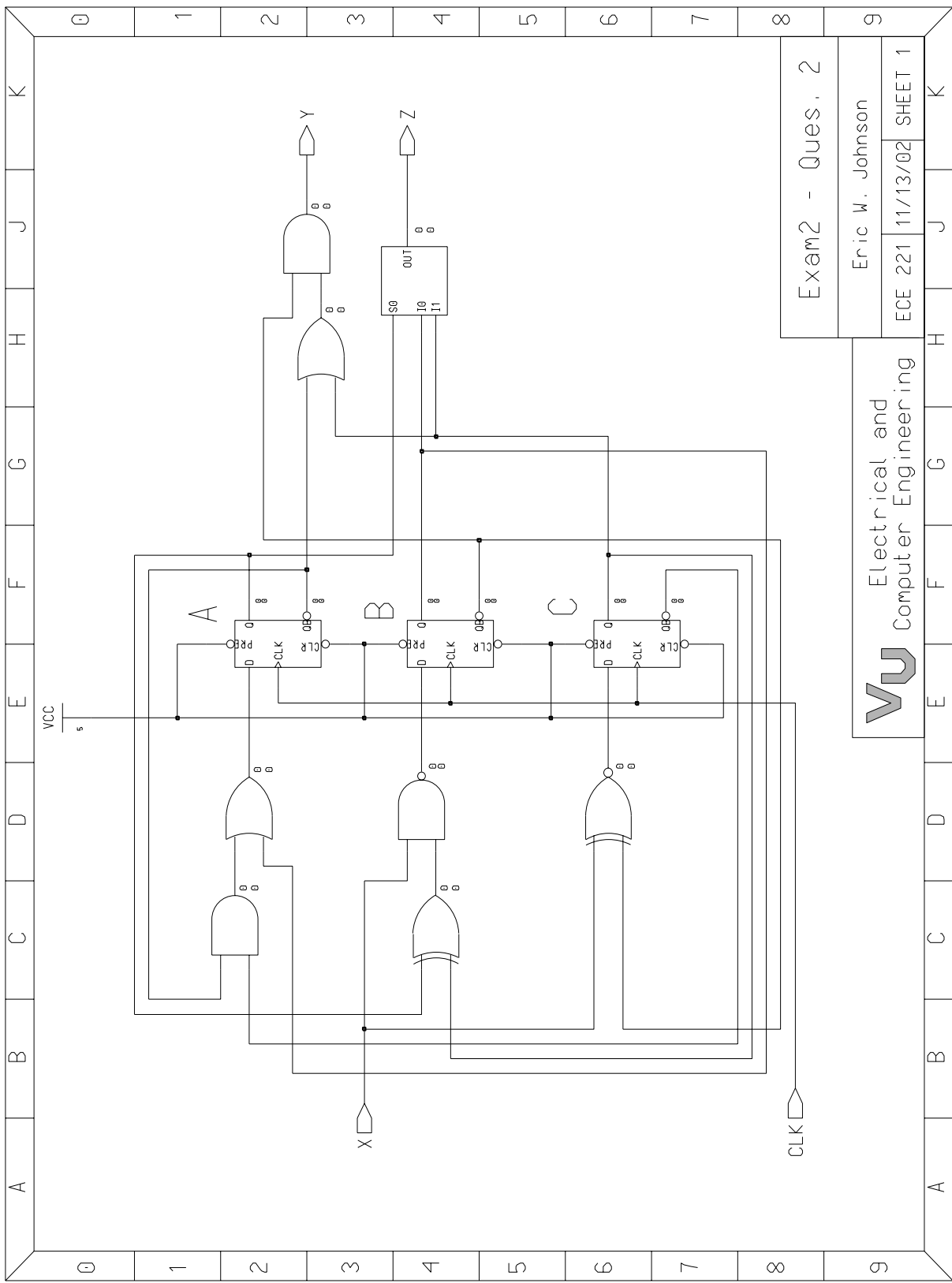
c) (13 points) Complete the state transition table shown below

Current State			Input	Next State			Outputs	
Q_A	Q_B	Q_C	X	Q_A^+	Q_B^+	Q_C^+	Y	Z
0	0	0	0					
0	0	0	1					
0	0	1	0					
0	0	1	1					
0	1	0	0					
0	1	0	1					
0	1	1	0					
0	1	1	1					
1	0	0	0					
1	0	0	1					
1	0	1	0					
1	0	1	1					
1	1	0	0					
1	1	0	1					
1	1	1	0					
1	1	1	1					

Question 2: Sequential Circuit Analysis (cont.)

d) (13 points) Draw the state diagram for the circuit using the key and states below. (make sure your arrows and labels are neat!!)





Exam2 - Ques. 2

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VU Electrical and Computer Engineering