

**VIRGINIA STATE UNIVERSITY
COMPUTER ENGINEERING
CPEG207 INTRODUCTION TO DIGITAL SYSTEMS TEST 3 FALL 20**

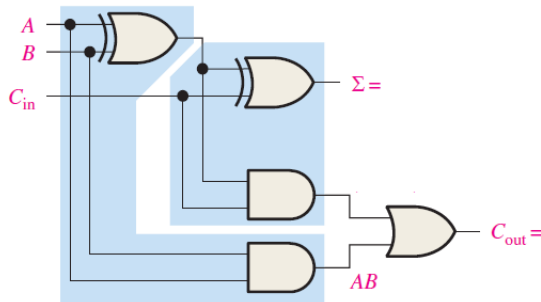
NAME : _____

1. For each statement, indicate whether it is referring to a DECODER, an ENCODER, a MUX, or a DEMUX:

(Note: Each statement may refer to more than one device.)

- (a) Produces a binary code at its output.
- (b) Can be used to route an input signal to one of several possible outputs.
- (c) Uses SELECT inputs.
- (d) Can be used to interface a BCD input to an LED display.
- (e) Has more inputs than outputs.
- (f) Only one of its outputs can be active at one time.
- (g) Can be used to generate arbitrary logic functions.

2. A) i) For the logic schematic for a Full Adder, determine the Boolean expressions for the Sum and the Output Carry.



$\Sigma =$

$C_{out} =$

- ii) For the Full Adder operation, write a VHDL program and a Verilog program.

VHDL

Verilog

entity

module

2. B) The truth table for a full adder is shown below. What are the values of X, Y and Z?

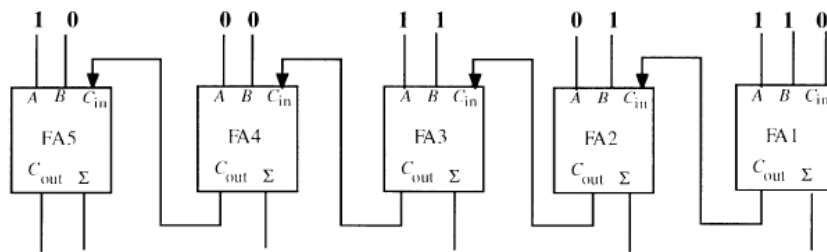
P	Q	CI	CO	Σ
0	0	0	0	0
0	0	1	0	X
0	1	0	0	1
0	1	1	Y	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	Z

X =

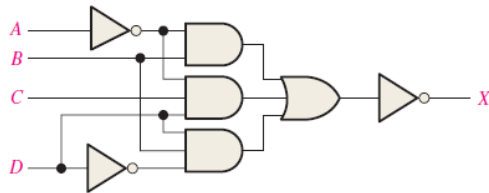
Y =

Z =

2. C) For the parallel adder shown below, determine the complete sum by analysis of the logical operation of the circuit. Verify your result by longhand addition of the two input numbers.



3. A)



i) Implement the logic circuit using only NAND gates:

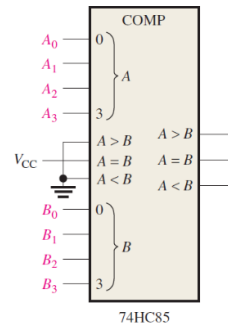
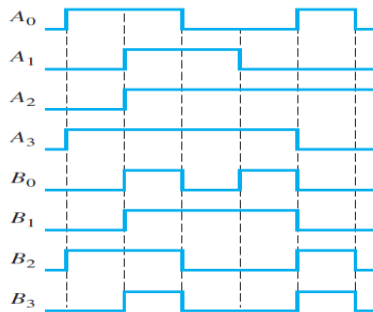
ii) Implement the logic circuit using only NOR gates:

3. B) Use a Karnaugh Map to obtain a minimum SOP and a minimum POS for the Truth Table shown below.

A	B	C	D	X
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	0
1	1	1	0	1
1	1	1	1	0

Draw the circuits for the min SOP and the min POS

3. C) For the 4-bit comparator, plot each output waveform for the inputs shown. The outputs are active-HIGH.

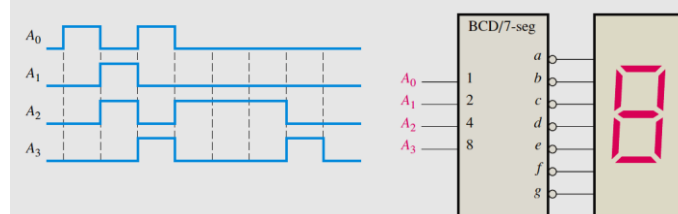


A > B

A = B

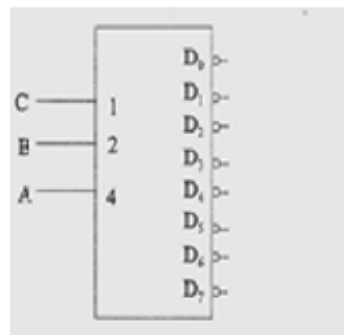
A < B

3. D) A 7-segment decoder/driver drives the display. If the waveforms are applied as indicated, determine the sequence of digits that appears on the display.



4. Three sliding doors labelled A, B and C respectively, lead to a “clean room” in a research facility. Each door is monitored by a switch. Using a 3-to-8 decoder and appropriate gates, devise a circuit to illuminate:
- (a) a green LED, referred to as GREEN, if A is opened and both B and C are closed; or A is closed and both B and C are opened.
 - (b) a yellow LED, referred to as YELLOW, if B is opened and both A and C are closed; or B is closed and both A and C are opened.
 - (c) a red LED, referred to as RED, if C is opened and both A and B are closed; or C is closed and both A and B are opened.
- Assume these logic levels: Door closed = 1; LED on = 0; decoder outputs = active-LOW

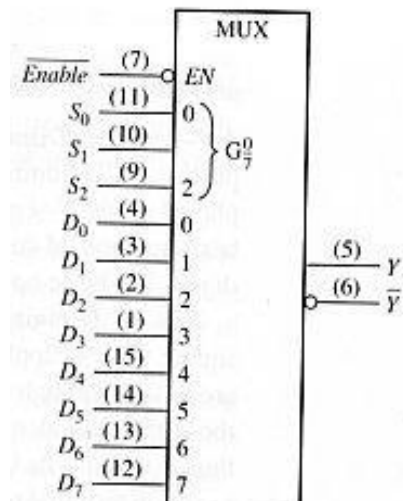
A	B	C	GREEN	YELLOW	RED
0	0	0			



5. Design a circuit using the 74151 8-to-1 Multiplexer and necessary gates to implement the following logic function. Assume that D is the MSB and A is the LSB.

$$\text{EVEN} = (D+C)(B+A)$$

D	C	B	A	EVEN
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	



74151