19ECE204 Digital Electronics and Systems
Midterm Evaluation

Duration: 1 hour 45 min
Max. Marks: 40

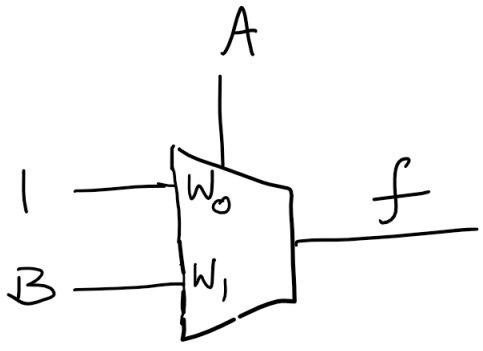
Part A: Short Answer Questions (10 x 1 = 10 marks – Provide brief steps and justifications for your answers (recommended time to be spent for this section is not more than 30 min)

1. Which of the following is NOT a minterm of the Boolean function
   $F(x_1, x_2, x_3, x_4) = x_1 x_2 x_3 + x_4' x_1' + x_2' x_3'$
   (a) 0
   (b) 6
   (c) 2
   (d) 1
   (e) 13

2. Two Boolean SoP expressions are equivalent if
   (a) Their truth tables are same
   (b) Their K-Maps are identical
   (c) Their canonical SoP forms are same
   (d) All of the above are true
   (e) None of the above is true

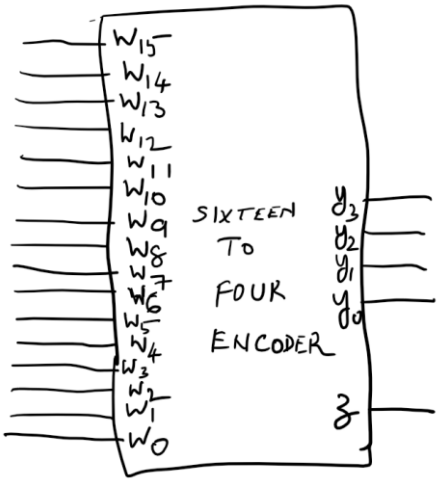
3. What is the cofactor of x_1 in the Shannon's expansion of the function $F(x_1, x_2, x_3) = x_3 + x_2'$ (steps to be shown)
4. The hardware cost of realizing a function using only MUXes
   (a) Depends on the Boolean expression
   (b) Depends on the number of variables in the function only
   (c) Depends on the number of minterms
   (d) Depends on the number of prime implicants
   (e) None of the above

5. What is the Boolean expression of *f* in the following circuit?



6. A decoder has 1024 output lines. How many address lines does it have?
7. When a decoder is working as a demultiplexer
   (a) The enable is used as the data input
   (b) The enable is not used
   (c) The enable is set to 0
   (d) None of the above

8. In the priority encoder shown below, the hex value of the 16-bit input is 038F H. What are the binary values of the 4-bit output $y_3\ y_2\ y_1\ y_0$ and the output z ? The priority is highest for the input w_{15} and decreases progressively till w_0 which has the least priority.

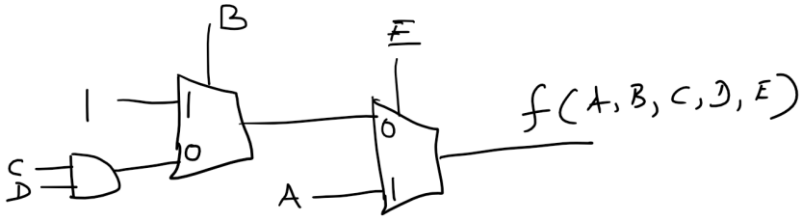


9. When arithmetic overflow occurs,
   (a) The carry out from the MSB position and the (MSB – 1)th position are different
   (b) The carry out from the MSB position and the (MSB – 1)th position are same
   (c) The carry out from the MSB position and the sign-bit position are different
   (d) The carry out from the MSB position and the sign-bit position are same
   (e) None of the above
10. Write down the binary and BCD representations of the decimal number 15.

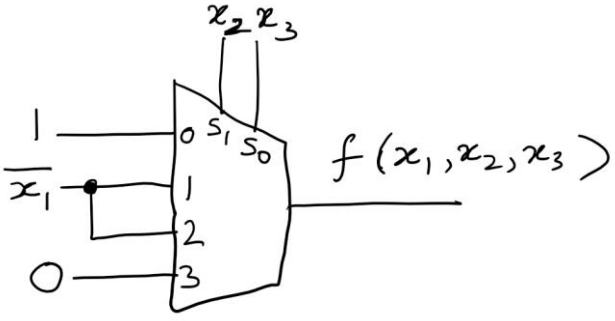
Part B: Problems (6 x 5 marks = 30 marks)

1. Use tabulation method for obtaining a minimal expression for the following truth table
   $F(x_1, x_2, x_3) = \sum m\ (0,1,4,5,6)$
2. Determine the minimized expressions for the Boolean functions realized by the following circuits.

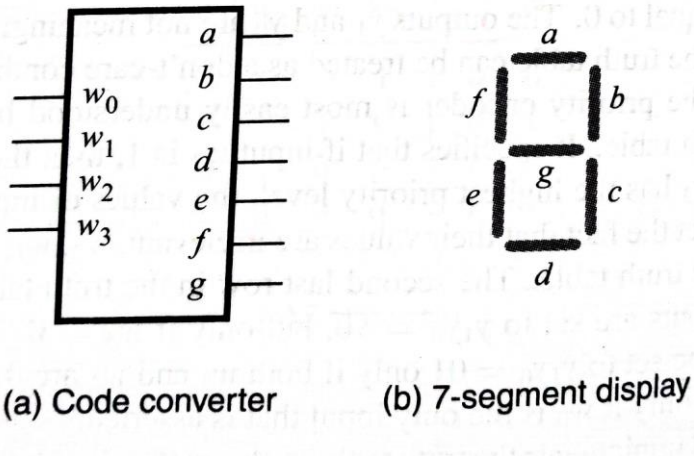
Ckt. (a)



Ckt (b)



3. Determine the expressions for the carries in a 3-bit CLA. Hence draw the circuit of the CLA.
4. Derive the minimal SOP expressions for the segment *a* in the BCD to seven segment converter circuit whose block diagram is shown below



(a) Code converter (b) 7-segment display

5. A motor speed controller is to be designed with four user switch positions: *slow*, *medium*, *fast* and *turbo*. Depending on the choice (only a single choice can be made), a digital block has to be designed to send a command word to the controller indicating the speed to be set. What will be the number of bits in the command word? Which combinational block would you use for this purpose? Show how you will use it?

6. Implement a 2-bit comparator for comparing two 2-digit binary numbers A = a_1a_0 and B = b_1b_0. If A = B, an output *AeqB* is made logic 1. If A > B, an output *AgtB* goes logic 1. On the other hand, if A < B, an output *AltB* is made logic 1.