CSE260
Assignment 03 (Total Marks: 20)

This assignment must be handwritten. Show ALL steps in ALL questions.
Make sure that your circuit is efficient, meaning you should use the lowest number of components.
You may use external gates if required.

Answer Question 1,2,3,4
Question 5, 6 and 7 are ungraded

Question 1 (5 Marks)
Build a circuit that implements the 1's complement number system (3 bit) using encoder(s) and decoder(s).

Question 2: (5 Marks)
Implement the following boolean function using only both 4:1 mux and 2:1 mux in a single circuit. In your circuit, you should have more 2:1 mux than 4:1 mux.
$F(A,B,C,D) = \sum(0,1,2,7,8,10,11,13, 15)$
Use external gates if required.

Question 3 (5 Marks)
You want to build a calculator that can add or subtract two 4-bit numbers: X and Y. Now, if X is greater than or equal to 8, and Y is divisible by 12, then the calculator will do the operation X+Y (addition). Otherwise, the calculator will do the operation X-Y(subtraction). **Design** the circuit using a 4-bit parallel adder cum subtractor.

Question 4: (5 Marks)
Design a 13 person voter counting system using full and parallel adders. You must use encoder and decoder to build full adders, meaning you can't use full adders directly.

Question 5: (Ungraded)
Implement the following boolean function using 2x4 decoder(s) only
$F(A,B,C,D,E) = \sum(0,1,2,7,8,10,11,13, 15,18,21,24,25)$
Use external gates if required.

Question 6: (Ungraded)
Consider A is a 4 bit number. Design A-3 (A minus 3) using a 4 bit parallel adder. Use external gates if required. The internal diagram for the parallel adder must be drawn using Encoders and decoders.
NB: Inside the parallel adder, the components you see are basic full adders. For a 4 bit parallel adder, you need 4 full adders. Those full adders must be built using encoder(s) and decoder(s).

Question 7 (Ungraded)
Implement the following using only 4x16 decoder(s).
$F(A,B,C,D) = \sum (0,1,2,8,10,11,14,15)$
If you need to use OR gates, make sure to build them using 4:1 mux(s).