EE1005 – Digital Logic Design
Assignment 3
Spring 2024

Instructor: Muhammad Adeel Tahir
Sections: BS-CS 2F, BS-SE 2A, BS-SE 2B

Maximum Marks: 100 **Due Date:** Tuesday, 19 March 2024

- Partially or fully **copied assignments** will be marked as **zero**.
- Only **handwritten** solution on **A4 page** will be accepted.
- Submission on the GCR by the deadline is **Compulsory.**
- Late submissions are not allowed. In case of late submission, assignment will not be accepted.
- Clearly indicate all the calculations in your solution. No points will be awarded in case of missing calculations.
- You can submit your assignment **during the class** on due date. But submitting on GCR as mentioned is compulsory.

Question Number 1 **(5 + 2.5 + 2.5 = 10 marks)**

Draw the two-level NAND implementation of the following Boolean functions.

a) **F(w, x, y, z) = Σ(2, 3, 4, 5, 7, 8, 10, 13, 15)**
b) **F(A, B, C, D) = AC'D' + A'C + ABC + AB'C + A'C'D'**
c) **F(A,B,C,D,E)= A.B + C.D + E**

Question Number 2 **(5 + 5 = 10 marks)**

Draw the two level NOR implementation of the following Boolean functions.

a) **F(w, x, y, z) = Σ(0, 2, 3, 8, 9, 12, 13, 15)**
b) **F(A, B, C, D) = Π(0, 2, 3, 9, 11, 12, 13, 15)**

Note
For NAND implementation, the first level of gates must be with AND-Invert symbols.
For NOR implementation, the first level of gates must be with OR-Invert symbols.

Question Number 3 **(10 + 10 = 20 marks)**

Draw the two-level NAND and NOR implementations of the following Boolean function F, together with the don't-care conditions d.

a) **F(A, B, C, D) = Σ(0, 6, 8, 13, 14)** **d(A, B, C, D) = Σ(2, 4, 10)**
b) **F(A, B, C, D) = Π(2,5, 6, 7, 12, 13,14)** **d(A, B, C, D) = Π (3, 9, 11, 15)**

Question Number 4 **(2+2+2+2+2=10 marks)**

The simplified Boolean functions are given below. Draw their equivalent k-maps.

a) F(A,B,C) = AB+BC+A'B'C'
b) F(A,B,C) = B'+A'C'+AC
c) F(A,B,C,D) = A'B+A'C'+AB'D
d) F(A,B,C,D) = D'+AB'C+BC'
e) F(A, B, C, D) = B+A'C+AC'D

Note: A neat and clean diagram is necessary for this question, properly show grouping or no marks will be given.

Question Number 5 **(10 marks)**

Implement the circuit by using 2-input NAND gates only.

$$\boldsymbol{F(A,B,C,D) = \overline{(\overline{AC})}.\overline{(\overline{\bar{B}C})}.\overline{(\overline{AB\bar{C}})}}$$

Note: To gain maximum marks, label each output carefully and it must be in neat handwriting. In case, the circuit labelling is not readable, partial or no marks will be given.

Question Number 6 **(4 + 6 = 10 marks)**

Simplify the following Boolean expression by using k-map and POS form and then implement the circuit by using 2-input NOR gates.

$$\boldsymbol{F(A,B,C,D) = A'B'C'D + CD + AC'D}$$

Question Number 7 **(10 marks)**

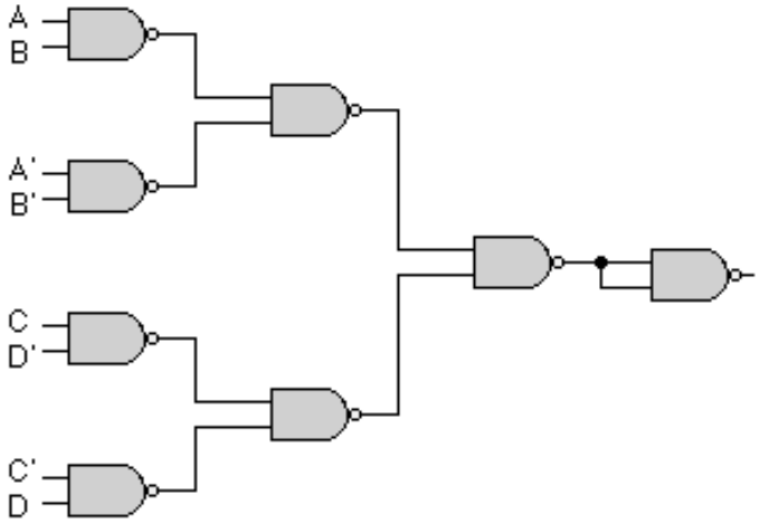
Draw the multi-level NOR circuit for the following expression:

$$\boldsymbol{F = CD(B + C)A + (BC' + DE')}$$

Question Number 8 **(10 + 10 = 20 marks)**

Convert the following circuit to use only AND-OR gates.

Circuit (A)



CIRCUIT (B):