COE 200, Term 023
Fundamentals of Computer Engineering
Quiz# 4

Date: Monday, July 28, 2003

Q.1. You are required to design a combinational circuit that computes the remainder of dividing a 4-bit number $N_3N_2N_1N_0$ by 3. For example, the remainder of dividing the number 1010 by 3 is 01 and the remainder of dividing the number 0101 by 3 is 10.

   a. Derive the truth table showing the relation between inputs and outputs

N_3	N_2	N_1	N_0	R_1	R_0
0	0	0	0	0	0
0	0	0	1	0	1
0	0	1	0	1	0
0	0	1	1	0	0
0	1	0	0	0	1
0	1	0	1	1	0
0	1	1	0	0	0
0	1	1	1	0	1
1	0	0	0	1	0
1	0	0	1	0	0
1	0	1	0	0	1
1	0	1	1	1	0
1	1	0	0	0	0
1	1	0	1	0	1
1	1	1	0	1	0
1	1	1	1	0	0

   b. Derive simplified sum of products expressions for the outputs.

R_1

N_3N_2 \ N_1N_0	00	01	11	10
00	0	0	0	1
01	0	1	0	0
11	0	0	0	1
10	1	0	1	0

R_0

N_3N_2 \ N_1N_0	00	01	11	10
00	0	1	0	0
01	1	0	1	0
11	0	1	0	0
10	0	0	0	1

$R_1 = N_3'N_2'N_1N_0' + N_3'N_2N_1'N_0 + N_3N_2N_1N_0' + N_3N_2'N_1'N_0' + N_3N_2'N_1N_0$

$R_0 = N_3'N_2'N_1'N_0 + N_3'N_2N_1'N_0' + N_3'N_2N_1N_0 + N_3N_2N_1'N_0 + N_3N_2'N_1N_0'$