INDRAPRASTHA INSTITUTE OF INFORMATION TECHNOLOGY DELHI
ECE 111 DIGITAL CIRCUITS
MID-SEMESTER EXAMINATION

Date: February 23, 2021 Time: 11:00AM to 12:00PM

Note: This is an open Book and open Notes examination with no consultation. Remain logged in during the exam and also remain unmuted. I should be able to hear your conversations, if you contact any one in the class as well as read any chat if anyone engages in a chat with his/her classmate.

Q1. a) For the function f(w,x,y,z) given in the K-map, identify the Prime Implicants (minterms) and Essential Prime Implicants (minterms). Also obtain the minimized SOP term for the same.

b) For the function in Fig. Q1, give a realization using only 2-input NOR gates.

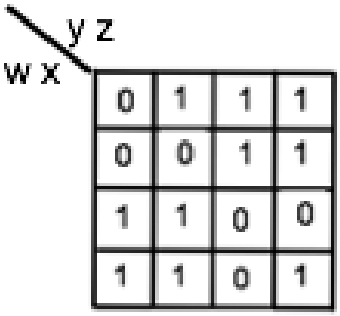

Fig. Q1

Q2. Decimal numbers can be coded in various binary codes. The excess-3 BCD and the 5-4-2-1 codes for the decimal digits 0-1-2-3-4-5-6-7-8-9 are as follows.

Excess-3 ($E_3\ E_2\ E_1\ E_0$) : 0011-0100-0101-0110-0111-1000-1001-1010-1011-1100,

5-4-2-1: ($C_3\ C_2\ C_1 C_0$) : 0000-0001-0010-0011-0100-1000-1001-1010-1011-1100.

(a) Construct Karnaugh maps for the two output variables ***C_1 and C_0*** in terms of the four input variables ***$E_3\ E_2\ E_1\ E_0$***, marking as "don't care" (***X or ϕ***) the combinations that do not correspond to any decimal digit.

(b) Read the K-maps to obtain minimal SOP expressions for the output variables ***C_1 and C_0***.

(c) Find the number of NAND chips required for implementing the logic, given quad 2-input NAND Gates.

Q3. A computer, using 3-digit radix complement arithmetic with an unknown radix *r*, gives the following results expressed in radix complement form:

$$(m+n)_r = (087)_r; \quad (m-n)_r = (005)_r; \quad (n-m)_r = (184)_r$$

Identify the radix r and the decimal values of m and n.

Q4. A robot has **four** permitted directions of movement and **three** possible speed settings. Let the direction control and the speed control be applied through two bits each:

D_1D_0 = 00(forward) / 11(reverse) / 01(right) / 10(left), and

S_1S_0 = 00(zero, no movement) / 01(low) / 10(medium) / 11(high).

It is desired to have an electronic protection system to ensure that the robot can move at high speed for forward movement only and reverse only at low speed. This will have to be achieved by generating an output bit **P** which should go HIGH if any of these two conditions is violated, and then using **P** to shut off the power to the robot. Write down the Boolean expression for the output pin the sum of products form in terms of **D_1**, **D_0**, **S_1**, **S_0**.

BEST OF LUCK