Name of Student --- Enrolment No. ------------------

Department / School ----------------------------

BENNETT UNIVERSITY, GREATER NOIDA
Mid Term Examination, Even SEMESTER 2019-20

COURSE CODE: ECSE104L

MAX. DURATION: **I Hr**

COURSE NAME: Digital Design

MAX. MARKS: **20 Marks**

Note: (1) Calculator is not allowed.

(2) No marks will be allotted for stating the final answer without intermediate steps.

Q.1 Assume that the following expressions holds good, then calculate the value of "X".

(2 Marks)

$$(11)_2 + (22)_3 + (33)_4 + (44)_4 = (X)_6$$

Q.2 Perform the subtraction of **212** from **121** using the following methods in **base – 3**:

(1 Mark)

(a) Diminished radix complement.

(b) Radix complement.

Q.3 Design a BCD to Excess-3 converter circuit. Clearly depict the following stages of the design process:

(1+2+1 = 4 Marks)

(a) Truth Table for converting the 4-bit BCD Code (A B C D) input to corresponding excess-3 output code (W X Y Z).

(b) Derive the SOP expression for each of the output bits (W), (X), (Y) and (Z) using K-Map.

(c) Based on the above generated expression, draw a logic circuit for the converter.

(**Note: The input combinations 1010, 1011, 1100, 1101, 1110 and 1111 are invalid in BCD therefore they are treated as don't care terms**).

Q.4 Find the minimized expression for the following realization:
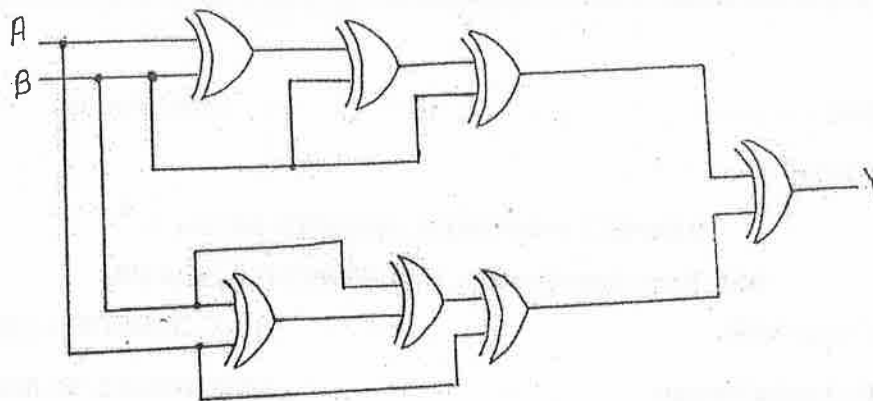
(1 Mark)

Fig. 1: Logic Circuit

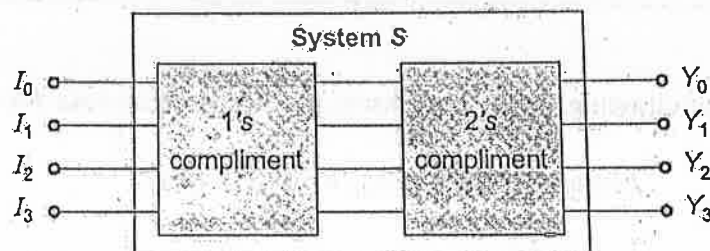**Q.5** Consider a system S as shown in the figure below:

Fig. 2: System S

This system S performs 1's complement of the input and then 2's complement to produce the output. A new system H is designed in which three S systems are cascaded as shown in the figure below:
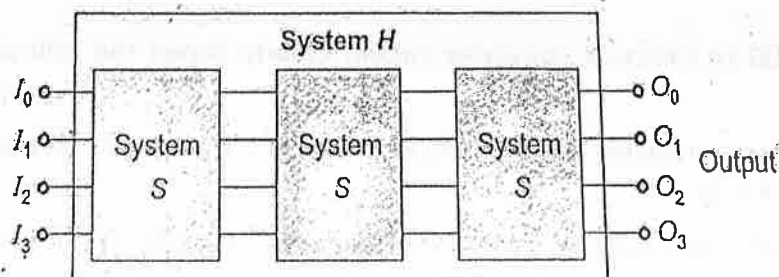

Fig. 3: System H

Compute the output $(O_3 O_2 O_1 O_0)$ using system H, if the applied input $(I_3 I_2 I_1 I_0)$ is **1010**.

(2 Marks)

Q.6 A car alarm system is to be designed considering 4 inputs: door closed (D), key in (K), seat pressure (S) and seat belt closed (B). The alarm (A) should sound for the following conditions i.e.

(i) the key is in and the door is not closed

OR

(ii) the door is closed, the key is in, driver on the seat so there is seat pressure and seat belt is not closed.

Determine the following for the above stated scenario: **(1+1+1 = 3 Marks)**

(a) Boolean expression that represent the above case.

(b) The circuit for the derived expression using basic gates (**AND, OR** and **NOT**).

(c) The number of gates required in the logic diagram.

Q.7 (a) Show that the dual of exclusive OR (EX-OR) is equal to its complement. **(1 Mark)**

(b) Calculate the final output if $(7E)_{16}$ and $(5F)_{16}$ are EX-ORed and the output is added to $(10)_{16}$. **(1 Mark)**

Q.8 Determine all the minimal expressions that can be generated using the K-MAP provided below: **(2 Marks)**

CD \ AB	00	01	11	10
00		1		1
01		1	1	1
11		1		1
10		1	1	1

Table 1: K-Map

Q.9 Draw the basic block diagram of a 4-bit binary adder-subtractor circuit. **(1 Mark)**

(Note: Use Full Adder as a block in the above logic circuit)

Q.10 Consider a track simulator which is designed as an equilateral triangle. At each of the three corners, three vehicles are present that can move either in clockwise direction or anti-clockwise direction. Let a binary **function f** denote the occurrence of a collision if any two vehicles meet in between on the track.

Find the simplest possible logic expression in both SOP and POS form that can represent the above stated condition of collision of vehicles provided that the direction of their movement is known. **(2 Marks)**

(Note: (1) All the vehicles are moving with the same speed, (2) Represent clockwise direction by "0" and anticlockwise direction by "1".)

--All the Best--