GIK Institute of Engineering Sciences and Technology, Topi
Fall 2021 (FCSE) Midterm
29th November 2021, 08:00 am – 09:15 am

Course Code: CE221	**Course Name: Logic Design**
Instructor Name : Engr. Ahsan Shah	
Student Name:	**Registration No:**

- Read each question completely before answering it. There are **2 Sections and 7 pages only.**
- In case of any ambiguity, you may make assumption. But your assumption should not contradict any statement in the question paper.
- Write the answer in the space below each question.

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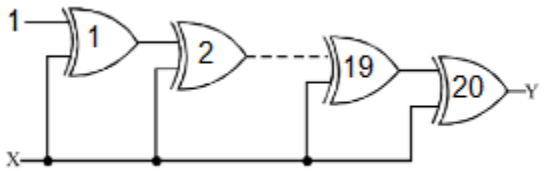
Time: 75 minutes. **Max Marks**: 50 points

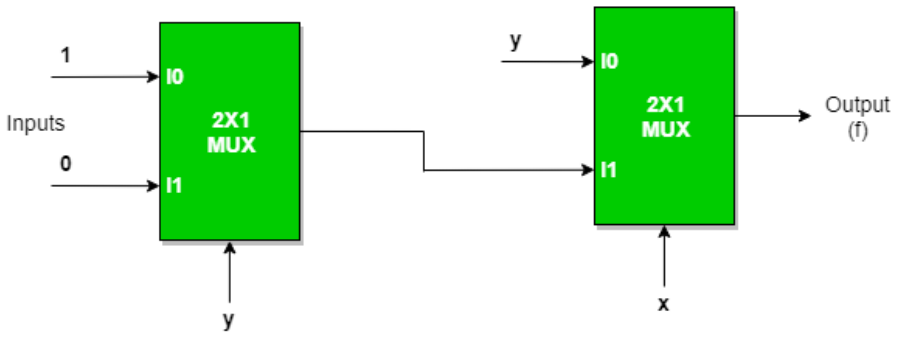
Section 1 (Short Questions) [4 point each]

1. If the input to the digital circuit (in the figure) consisting of cascaded 20 XOR gates is X, then output Y is equal to:



2. A binary code represents text, computer processor instructions, or any other data using a two-symbol system. Now we have some of the decimal numbers and you need to send them to your CPU in the form of their binary representation. Convert the following decimal numbers to their binary representation.
   i. -254
   ii. +254

3. Consider the following circuit and write its logical equivalent. Give proof of your answer using any proof method.



4. An automotive engineer wants to design a logic circuit that prohibits the engine in a car from being started unless the driver is pressing the clutch pedal while turning the ignition switch to the “start” position. The purpose of this feature will be to prevent the car from moving forward while being started if ever the transmission is accidentally left in gear.
   Suppose we designate the status of the ignition switch “start” position with the Boolean variable S (1 = start; 0 = run or off), and the clutch pedal position with the Boolean variable C (1 = clutch pedal pressed; 0 = clutch pedal in normal position). Write a Boolean expression for the starter solenoid status, given the start switch (S) and clutch (C) statuses. Then, draw a logic gate circuit to implement this Boolean function.

5. Two very important rules of simplification in Boolean algebra are as follows:

   Rule 1:

   Rule 2:

   Try to apply these two rules to the following Boolean expressions, identifying which rule directly applies, or if neither rule directly applies:

   Considering the above given as left hand side, what will the equivalent right hand side of these.

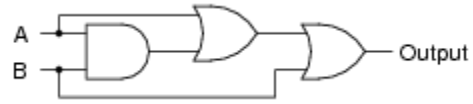
Section 2 (Long Questions)

1. Suppose you are working as a lead engineer in Suzuki Pakistan, it is observed that in hilly area Suzuki is experiencing fatal accidents due to failure of break of all four wheels. You are requested to design a simple and cost effective safety strategy to overcome and reduce chances of accidents.

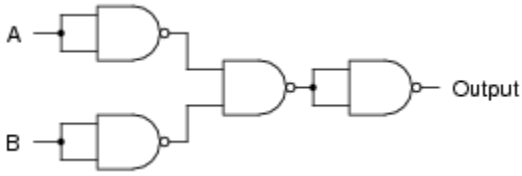
   It is an advice given by your higher management that if two or more than two breaks of wheels failed, an alarm must be triggered for the driver. This alarm will help driver to reduce speed or visit workshop for maintenance. **(10 Marks)**

2. Attempt following problem as per instructions given:

A. Use Boolean algebra to simplify the following logic gate circuit: **(6 Marks)**

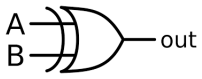


Circuit 1



Circuit 2

B. Design a circuit that takes four bit binary number as an input and convert it into its gray code. You have to use XOR gate wherever required. **(4 Marks)**



3. Design a combinational circuit with three inputs, x, y, and z, and three outputs, A, B, and C. When the binary input is 0, 1, 2, or 3, the binary output is one greater than the input. When the binary input is 4, 5, 6, or 7, the binary output is one less than the input. **(10 Marks)**

Boolean algebra Rules

1. $A + 0 = A$
2. $A + 1 = 1$
3. $A \cdot 0 = 0$
4. $A \cdot 1 = 1$
5. $A + A = A$
6. $A + \overline{A} = 1$
7. $A \cdot A = A$
8. $A \cdot \overline{A} = 0$
9. $\overline{\overline{A}} = A$
10. $A + AB = A$
11. $A + \overline{A}B = A + B$
12. $(A + B)(A + C) = A + BC$