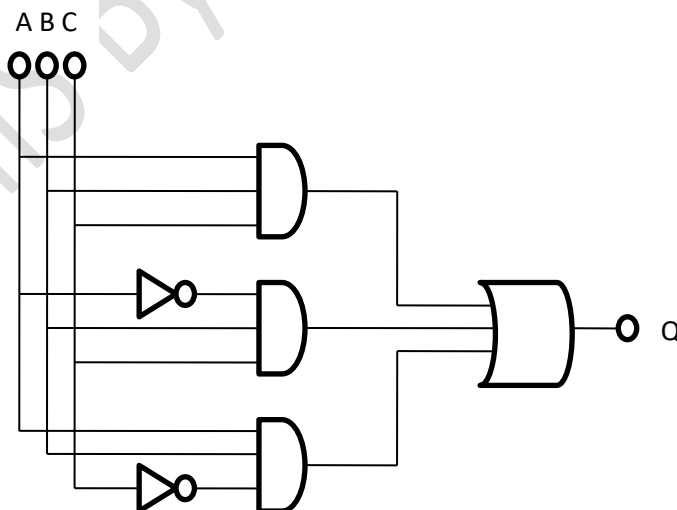


01. An alarm system has been designed to detect break-ins by using three detectors. They are a motion detector, a glass break detector and a blackout detector. A detector can either be active (sends the logical value 1) or inactive (sends the logical values 0). The system automatically detects a break in and triggers the alarm (sends the logical values 1) only when all the three detectors are simultaneously active, or the blackout detector and anyone of the Remaining detectors are active.
- Construct a truth table to represent the functionality of the above alarm system.
 - Derive the Boolean expression to represent the truth table constructed in section (a) above.
 - Simplify the Boolean expression to obtain in section (b) (i) above, using Boolean algebra. Clearly show all the workings and Boolean algebraic rules used for this simplification.
 - Construct the logic circuit for the simplified Boolean expression obtained in section (b) (ii) above
 - The analysis of the past incidents where the alarm triggered reveals that break-in attempts have been made only during blackouts. Do you agree with the above statement? Justify your answer.
02. (a) A fire alarm system consists of three sensors S1,S2 and S3 to detect smoke, flame and heat respectively. A sensor can either be active (sent the logical value 1) or inactive (sends the logical value 0),the system automatically triggers the fire alarm when at least two of the sensors are active.
- Construct the truth table to represent the functionality of the above fire alarm system.
 - Derive the Boolean expression to represent the above truth table.
- (b) Consider the logic circuit shows here to answer the (i) and (ii) below;



- (i) Write and simplify the Boolean expression for the above circuit using Boolean algebra. Show all the Working and algebraic Rules used for the simplification.
- (ii) Construct the logic circuit using a combination of only AND, OR and NOT gates for the simplified Boolean expression obtained in **section b (i)** above

03. (a) A fan in a room can be on (1) or off (0). A control system is required to operate the fan efficiently with the following condition / functionalities.

1. The fan can manually be switched on or off
2. The timer will be either on or off.
3. The sensor will detect whether the environment is cold or hot.
4. The fan will automatically be switched on when the timer is on and the sensor indicates the environment is hot.

The following table assigns Boolean values for the above conditions / functionalities.

Condition/functionality	Boolean value
Fan switched on manually	1
Fan switched off manually	0
Timer is on	1
Timer is off	0
Sensor detects cold environment	1
Sensor detects hot environment	0

- (i) Draw a logic circuit by using a combination of only AND, OR and NOT gates to implement the above control system.
- (ii) Construct a truth table to represent the functionality of the above system.
- (iii) Write Boolean expression (not simplified) to represent the truth table constructed in the (b) (ii) above.
