Switching Circuit Lab (CS29204)

Assignment-1

17.01.2022

Names:

- Devendra Palod *(20CS10024)*
- Subhajyoti Halder *(20CS10064)*
- Anuj Kakde *(20CS30005)*
- Deepiha .S *(20CS30015)*

Group No. **11**

Problem Statement-1

A safe has five locks v, w, x, y and z, all of which must be unlocked for the safe to open. The keys to the locks are distributed among five executives in the following manner:

- A has keys for locks v and x
- B has keys for locks v and y
- C has keys for locks w and y
- D has keys for locks x and z
- E has keys for locks v and z

a) Determine the minimum number of executives required to open the safe.
b) Find all the combinations of executives that can open the safe.
c) Design and implement a circuit which provides an output to check if a combination of executives can open the safe.

Solution:
(explanation)

The switches (labelled as A, B, C, D, E) represent whether an executive is called or not. The junctions *V, W, X, Y, Z* represent the locks (OR gates, as presence of at least anyone of the input i.e. executive is sufficient to open the lock). These are further joined by AND gates because iff all the locks are successfully opened, the final output will be "ON".

Now, by switching ON/OFF the switches, we can obtain the output for all permutations of executives.

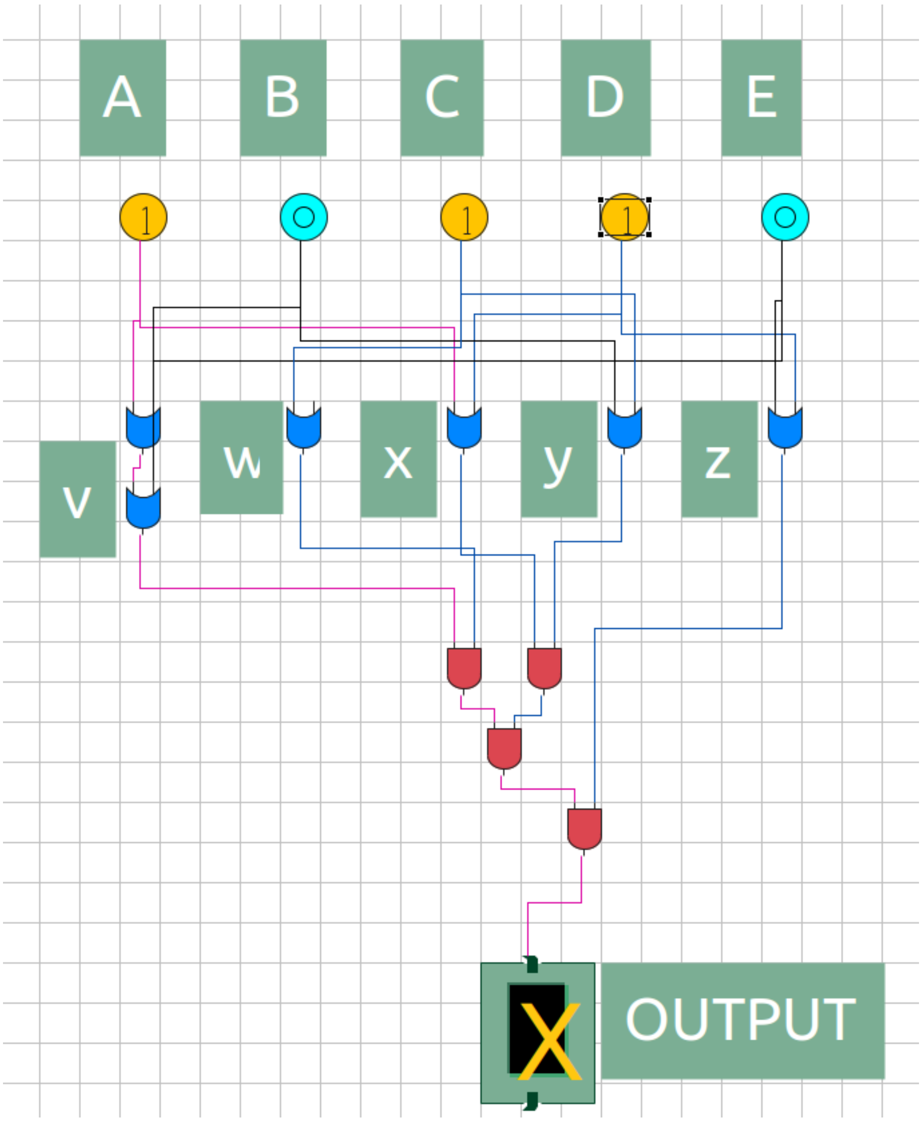
Answers:

A. Minimum number of executives required to open the safe = 3
B. Successful combinations of Executives:
    - A B C D E
    - A B C D
    - A B C
    - A C D E
    - A C D
    - A C E
    - B C D E
    - B C D
    - C D E
C. (Provided below)

Truth Table:

A	B	C	D	E	output
1	1	1	1	1	1
1	1	1	1	0	1
1	1	1	0	1	1
1	1	1	0	0	0
1	1	0	1	1	0
1	1	0	1	0	0
1	1	0	0	1	0
1	1	0	0	0	0
1	0	1	1	1	1
1	0	1	1	0	1
1	0	1	0	1	1
1	0	1	0	0	0
1	0	0	1	1	0
1	0	0	1	0	0
1	0	0	0	1	0
1	0	0	0	0	0
0	1	1	1	1	1
0	1	1	1	0	1
0	1	1	0	1	0
0	1	1	0	0	0
0	1	0	1	1	0
0	1	0	1	0	0
0	1	0	0	1	0
0	1	0	0	0	0
0	0	1	1	1	1
0	0	1	1	0	0
0	0	1	0	1	0
0	0	1	0	0	0
0	0	0	1	1	0
0	0	0	1	0	0
0	0	0	0	1	0
0	0	0	0	0	0

Circuit diagram



Problem Statement-2

Five soldiers A, B, C, D and E volunteer to perform an important military task if
the following conditions are satisfied:

- Either A or B or both must go
- Either C or E, but not both, must go
- Either both A and C go, or neither goes
- If D goes then E must also go
- If B goes then A and D must also go

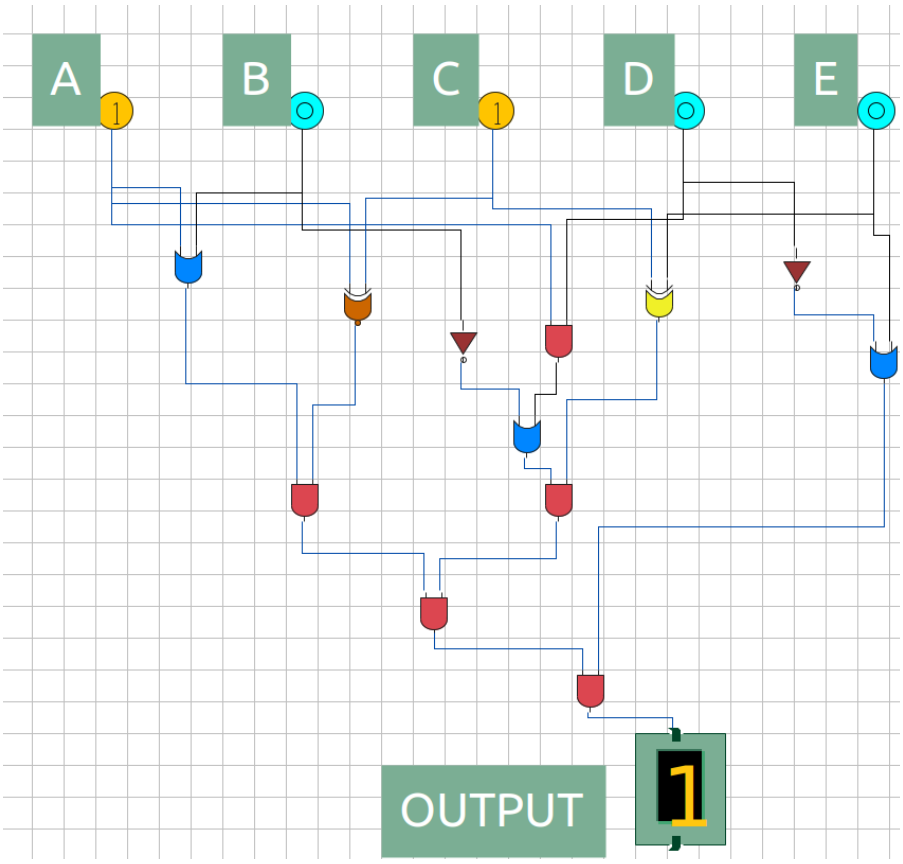
Define variables A, B, C, D, E such that an uncomplemented variable will mean that the corresponding soldier has been selected to go. Determine the expression that specifies the combinations of volunteers that can get the assignment. Design and implement a circuit which provides an output to decide if an input combination is a valid one.

Solution:
(explanation)

The switches (labelled as A, B, C, D, E) represent whether a soldier is volunteering for the assignment.
Now, by switching ON/OFF the switches, we obtain the output for all permutations of troops.

Expression: **A.(~B).(C).(~D).(~E)**

Circuit diagram



Problem Statement-3	
	You are presented with a set of requirements under which an insurance policy will be issued. The applicant must be: 1. A married female 25 years old or over, or 2. A female under 25, or 3. A married male under 25 who has not been involved in a car accident, or 4. A married male who has been involved in a car accident, or 5. A married male 25 years or over who has not been involved in a car accident. Define appropriate variables to capture the requirements. a) Find an algebraic expression that assumes the value 1 whenever the policy should be issued. b) Simplify algebraically the above expression and suggest a simpler set of requirements. c) Design and implement a logic circuit to provide an output to decide if the insurance policy can be issued

Solution: (explanation)	
	Since all the categories are binary, we decided that each switch will represent each category. A. M/F: 1=Male 0=Female B. Age: 1= under 25yrs age 0= not under 25yrs age C. Married: 1=married 0=unmarried D. Accident: 1=involved 0=not involved

Now we toggle the switches to simulate all possible conditions and determine whether or not an insurance policy will be issued.

Expression:

Initial Expression: $\bar{A}\cdot\bar{B}\cdot C + \bar{A}\cdot B + A\cdot B\cdot C\cdot\bar{D} + A\cdot C + A\cdot\bar{B}\cdot C\cdot\bar{D}$

$= \bar{A}\cdot(\bar{B}\cdot C + B) + A\cdot C\cdot(1 + B\cdot\bar{D} + \bar{B}\cdot\bar{D})$

$= \bar{A}\cdot(\bar{B}\cdot C + B) + A\cdot C$

Final Expression

Truth Table:

A	B	C	D	output
0	0	0		0
0	0	0		0
0	0	1		1
0	0	1		1
0	1	0		1
0	1	0		1
0	1	1		1
0	1	1		1
1	0	0		0
1	0	0		0
1	0	1		1
1	0	1		1
1	1	0		0
1	1	0		0
1	1	1		1
1	1	1		1

Circuit diagram