# EE1025-Independent Project
# BOOLEAN FUNCTION IMPLEMENTATION

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**Abstract**

Any complicated function boils downs to gate level which is either sum of products (SOP) or product of sums(POS)!Indeed this technique is mostly represents deduced reduced logic function which is useful for logical designing.

## AIM

Understanding the fuctioning of SOP and POS and their importance.

## INTRODUCTION

Any Boolean function can be represented by using a number of logic gates by interconnecting them. Logic gates implementation or logic representation of Boolean functions is very simple and easy form.The implementation of Boolean functions by using logic gates involves in connecting one logic gates output to another gates input and involves in using AND, OR, NAND and NOR gates.(Logic gates are the basic building blocks of digital electronic circuits. A logic gate is a piece of an electronic circuit, that can be used to implement Boolean expressions.)

The prior difference between the SOP and POS is that the SOP contains the OR of the multiple product terms. Conversely, POS produces a logical expression comprised of the AND of the multiple OR terms.

Universal logic gates are NAND gate and NOR gates. The reason behind this is, NAND gate and NOR gate can perform (or can function like) all the 3 basic gates, such as AND gate, OR gate and NOT gate. We can design any basic logic gate by using NAND gate or NOR gate is also another method of implementing Boolean functions.

## APPARTUS

These experiments are conducted on an open-source LT-spice.Voltage sources within the range 0-5V and symmetric pulse of frequency within the range 1KHz - 5 KHz.

## THEORETICAL BACKGROUND

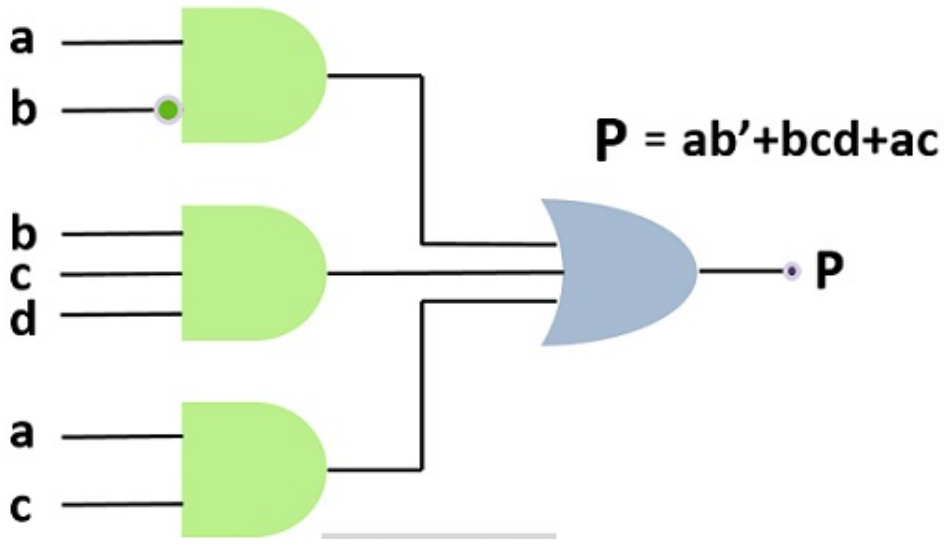
**SOP**:-

MIN-TERMS The sum of product or SOP form is represented by using basic logic gates like AND gate and OR gate. The SOP form implementation will have the AND gate at its input side and as the output of the function is the sum of all product terms, it has an OR gate at its output side.

Summarized as:-

| | |
|---|---|
| Input side | AND gate |
| Output side | OR gate |

Picturized as:-




**POS**:-

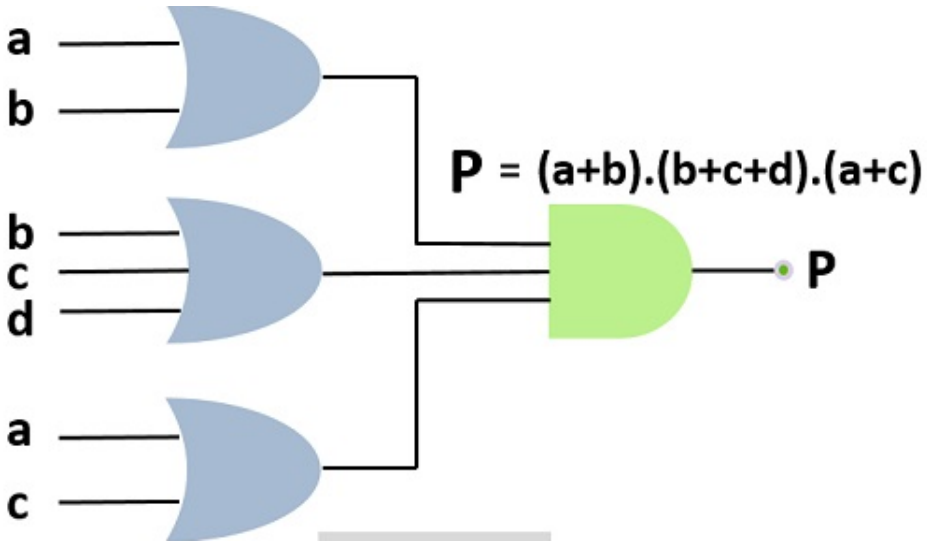
MAX-TERMS The product of sums or POS form can be represented by using basic logic gates like AND gate and OR gates. The POS form implementation will have the OR gate at

its input side and as the output of the function is product of all sum terms, it has AND gate at its output side. In POS form implementation, we use NOT gate to represent the inverse or complement of the variables.

Summarized as:-

| | |
|---|---|
| Input side | OR gate |
| Output side | AND gate |

Picturized as:-




Though they yeild the same result but one must note these differences:-

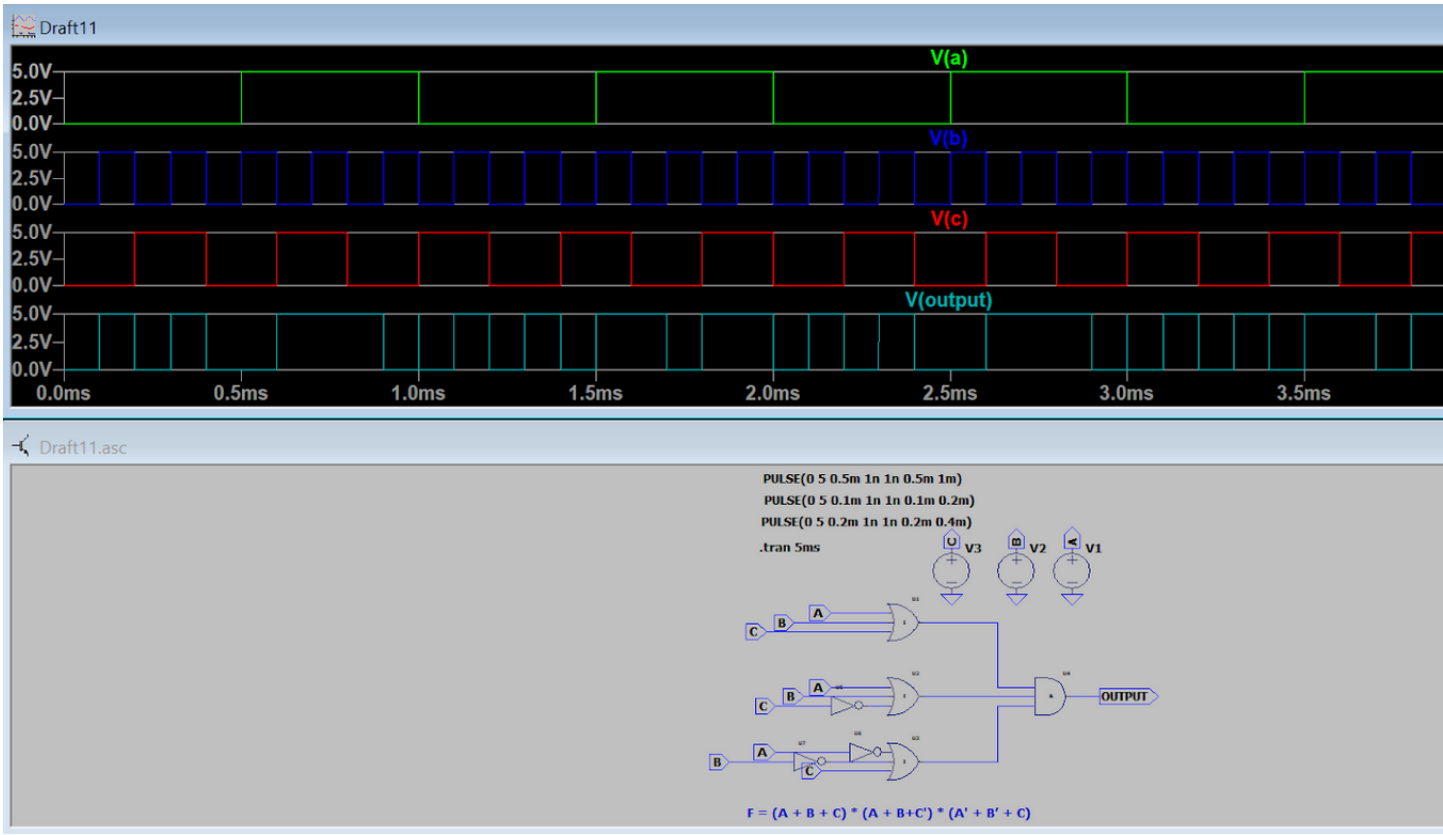
| BASIS FOR COMPARISON | SOP | POS |
|---|---|---|
| Expands to | Sum of Product | Product of Sum |
| Basic | Form of representation of a boolean expression incorporating minterms | Technique of generating a boolean expression involving maxterms. |
| Expression includes | Product terms are taken where the input set produces a value 1. | Only Sum terms which generate a value 0. |
| Method | 1 represents the variable and 0 is the complement of it. | 0 represents the variable and 1 complement of the variable. |
| Obtained through | Adding corresponding product terms. | Multiplying the relevant sum terms. |
| Order of implementation | OR gate is employed after the AND gate. | AND gate is used after the OR gate. |

**EXPERIMENTATION**

**Task-1:POS**

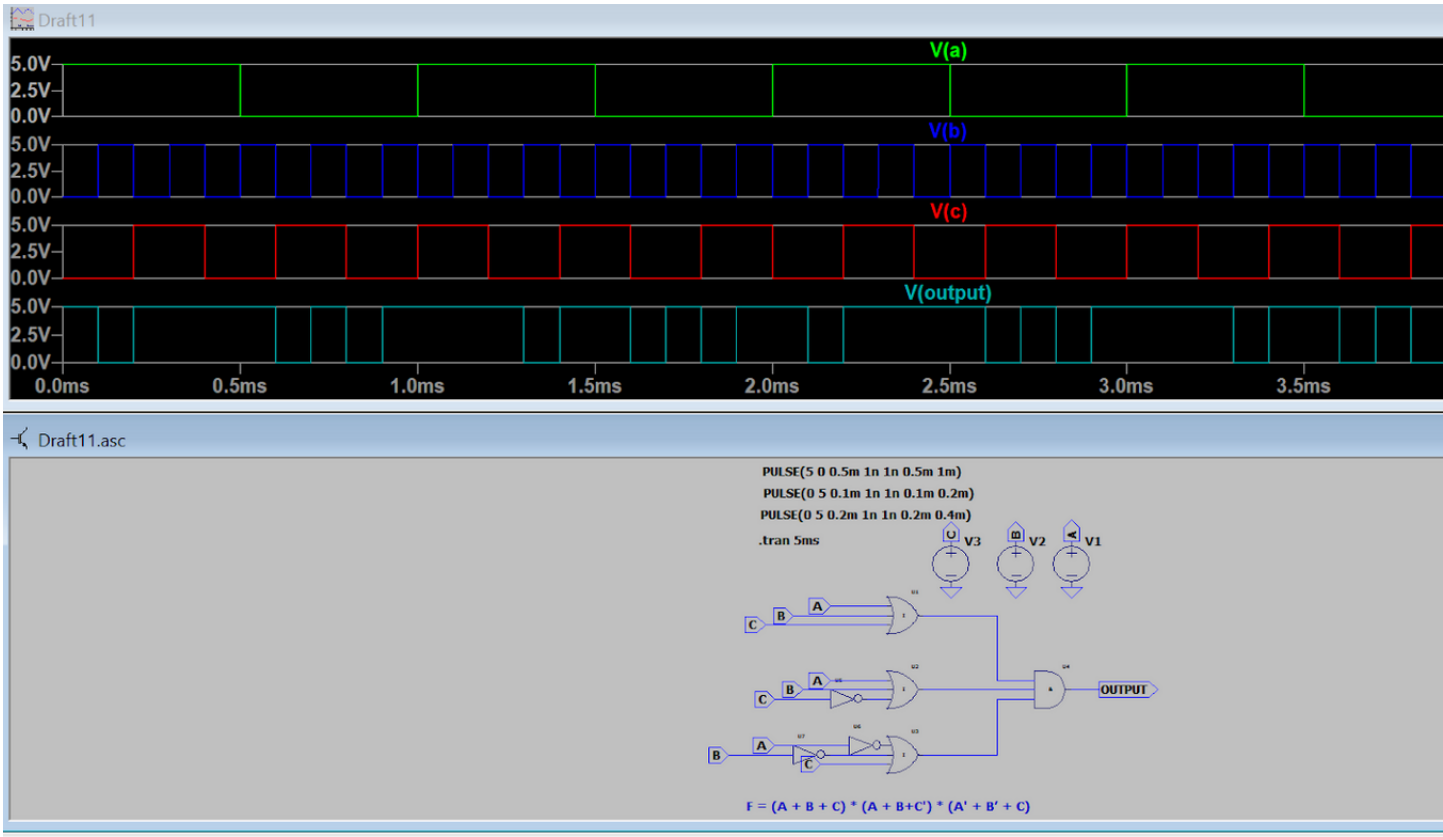
Step 1:-The input gates are driven through OR gates and output is at the AND.
Step 2:-The voltages are of high as 5V , low as 0V and duty cycle of 50 percent with V(A) frequency of 1 KHz,V(B) frequency of 5KHz ,V(C) frequency of 2.5KHz.
Step 3:-Simulating the above circuit for 5ms in transient analysis.

Outcomes:- It outputs the boolean expressions results as F=(A+B+C)*(A+B+C')*(A'+B'+C)




**Task-2:POS(tweaked)**

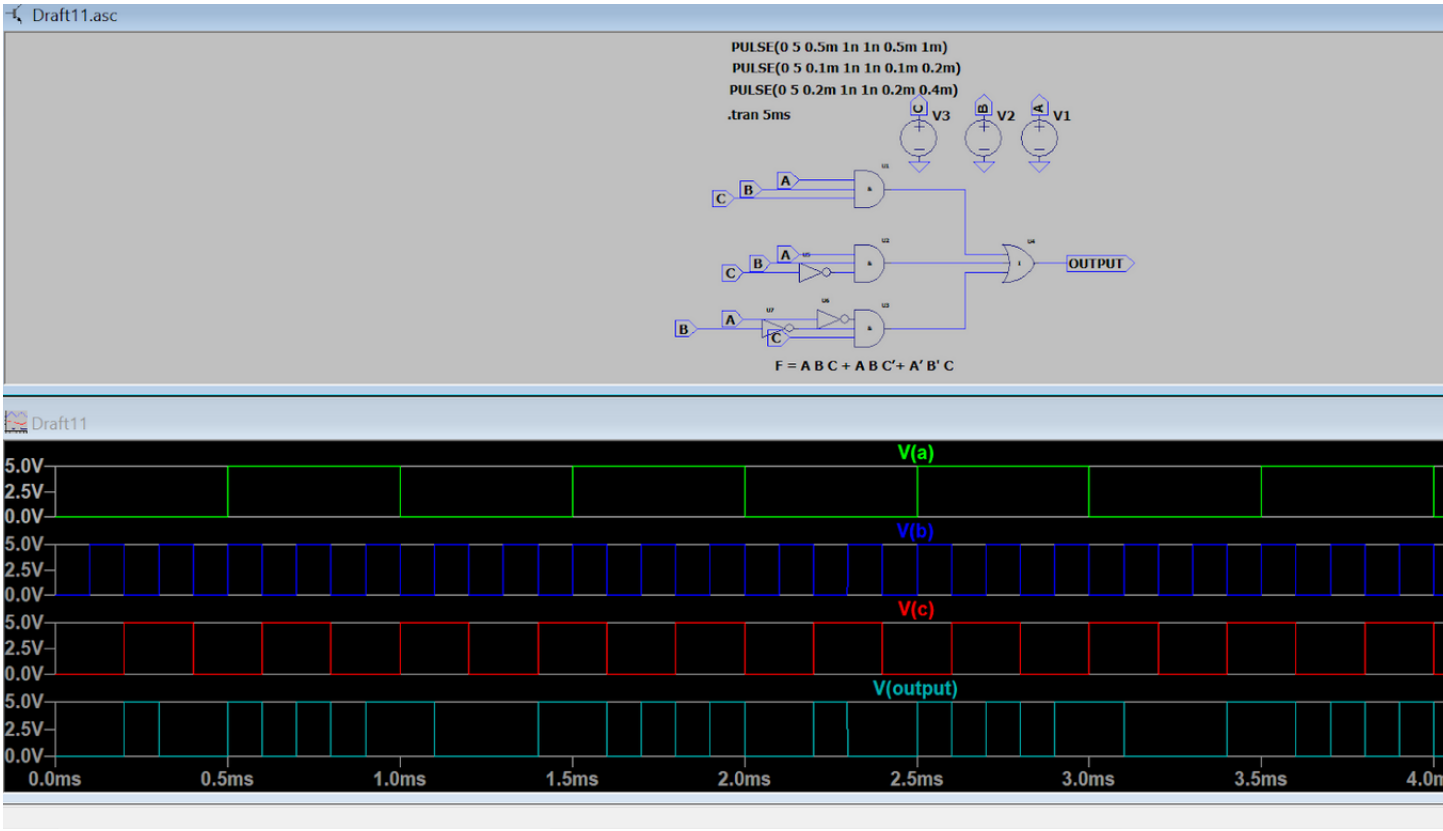
Similar steps as TASK -1 but V(A) is inverted , the output then turns out to be F=(A'+B+C)*(A'+B+C')*(A+B'+C)




**Task-3:SOP**

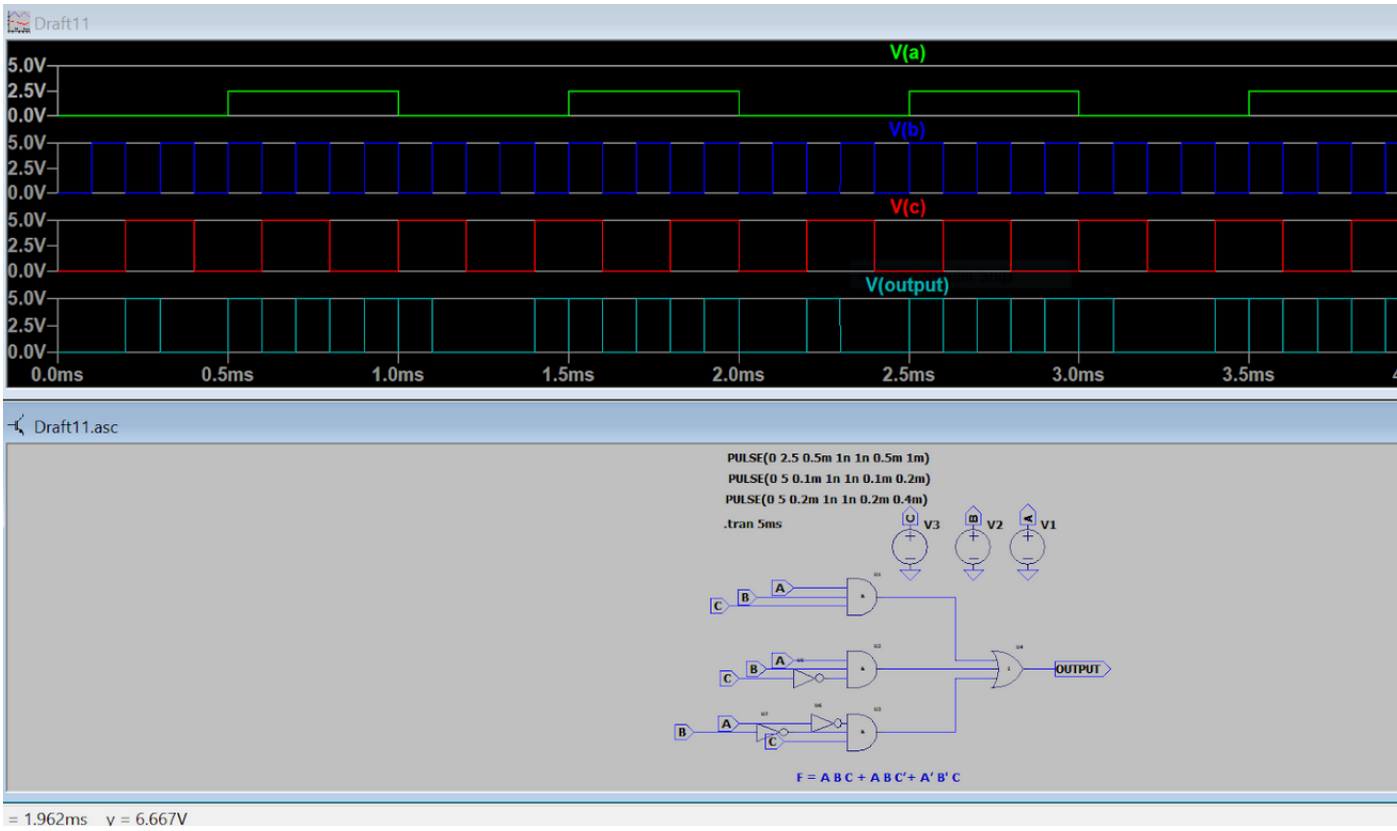
Step 1:-The input gates are driven through AND gates and output is at the OR.
Step 2:-The voltages are of high as 5V , low as 0V and duty cycle of 50 percent with V(A) frequency of 1 KHz,V(B) frequency of 5KHz ,V(C) frequency of 2.5KHz.
Step 3:-Simulating the above circuit for 5ms in transient analysis.

Outcomes:- It outputs the boolean expressions results as F=ABC+ABC'+A'B'C
We find the graph of TASK-1 and TASK-3 are same this concludes experimentally that both the SOP and POS.




**Task-4:SOP(tweaked)**

Similar steps as TASK-3 but V(A)'s high is changed to 2.5V ,this doesn't change the boolean expression indeed implies that voltages high and low values don't matter much the output consider the lowest voltage and highest among all.




## CONCLUSIONS

SOP and POS are really useful since they deduce large expressions in terms of basic gates.It is also imporatant to give the pulses in correct way since , duty cycle and Von would affect the output.

Thank you!