MPHY CC-12 — (P.G. Sem. III)

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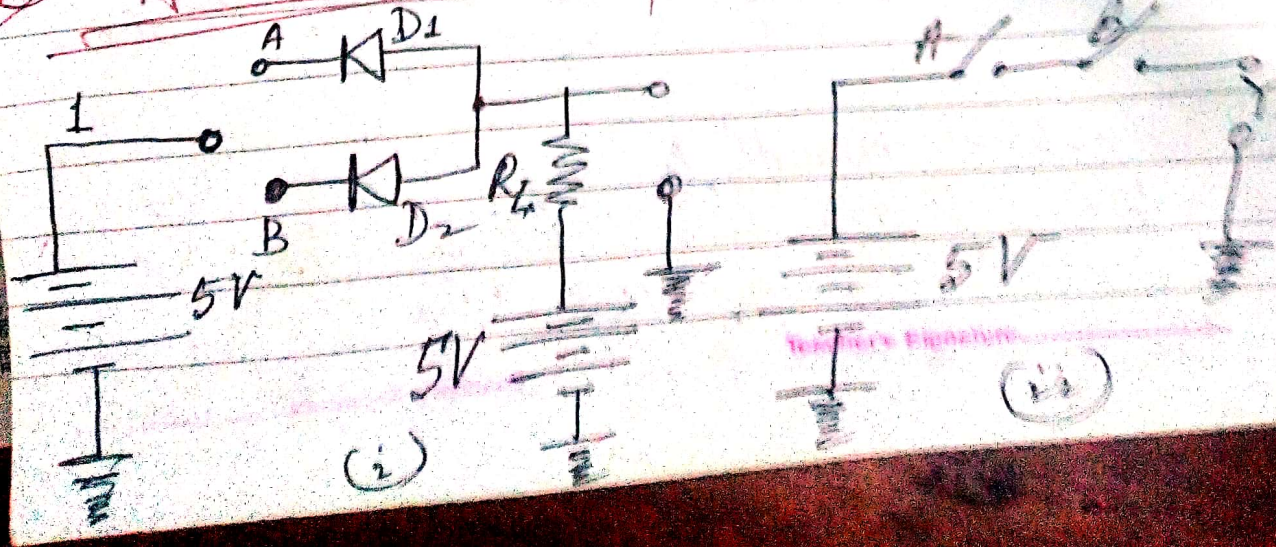
AND Gate

The AND gate is a logic gate that has two or more inputs but only one output. The output Y of AND gate is HIGH when all inputs are HIGH. However, the output Y of AND gate is LOW if any or all inputs are LOW.

It is called AND gate because output is high only when all the inputs are high. For this reason, the AND gate is sometimes called "all or nothing gate". For a 2-input AND gate the output will be high when both the inputs are high.

AND Gate Operation



A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

(iii)

Fig (1) shows one way to build a 2-input AND gate while fig. (1(ii)) shows its simplified schematic diagram. There are only four input - output possibilities.

(i) When both A and B are connected to ground, both the diodes (D_1 and D_2) are forward biased and hence they conduct current. Consequently, the two diodes are grounded and output voltage is zero. In terms of binary, when A = 0 and B = 0, then Y = 0 as shown in truth table in fig (1(iii)).

(ii) When A is connected to the ground and B is connected to the positive terminal of the battery, diode D_1 is forward biased while diode D_2 will not conduct. Therefore, diode D_1 conducts and is grounded. Again output voltage will be zero. In binary terms, when A = 0 and B = 1, then Y = 0 (as we desired) in the truth table.

(ii) When B is connected to the ground and A connected to the positive terminal of the battery, the roles of diodes are interchanged. Now diode D_2 will conduct while diode D_1 doesn't conduct. As a result, diode D_2 is grounded and again output voltage is zero. In binary terms, when A=1 and B=0, then Y=0.

(iii) When both A and B are connected to the positive terminal of the battery, both the diodes do not conduct. Now the output voltage is +5V because there is no current through R_2. It is clear from the truth table that for AND gate the output is high if all the inputs are high. However the output is low if any of all inputs are low.

(iv) Boolean expression:

A . B	=	Y
0 . 0	=	0
0 . 1	=	0
1 . 0	=	0
1 . 1	=	1

The Boolean expression for AND function is

$A \cdot B = Y$

AND symbol

Where the multiplication dot stands for the AND operation. The table for B=0, Fig. 2 show the different possibilities.