M.Sc. Sem III

MPHYCC - 12

electronics II

OP-amp

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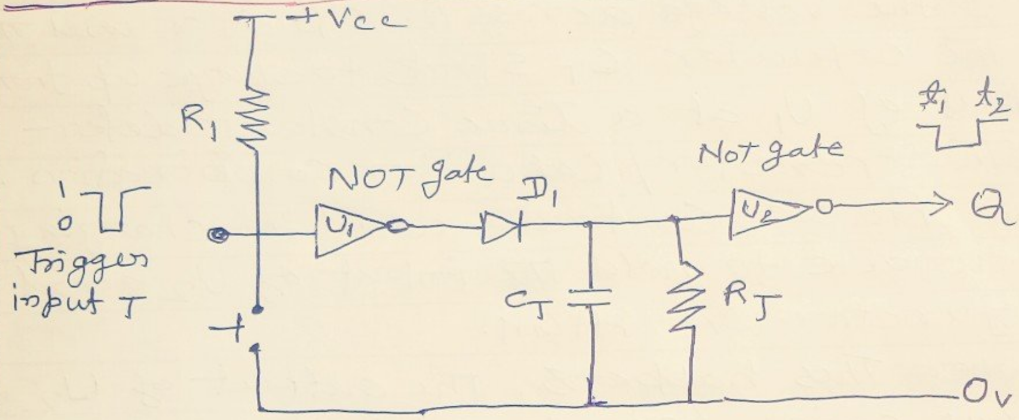
NOT Gate Monostable Multivibrator:-



As with the NAND gate circuit above initially the trigger input T is HIGH at a logic level "1" so that the O/T from the first NOT gate U_1 is LOW at logic level "0". The timing resistor, R_T and the capacitor, C_T are connected together in parallel to the input of the 2nd NOT gate U2. As the input to U2 is LOW its output at Q will be HIGH.

When a logic level '0' pulse is applied to the trigger input T of the first NOT gate it changes state and produces a logic level "1" output. The diode D1 passes this logic-1 voltage level to the RC timing network. The voltage across the capacitor, C_T increases rapidly to this new voltage level, which is also connected to the input of The second NOT gate. This in turn outputs a logic '0' at Q and the circuit stays in this Meta-stable state as long as the trigger input T applied to the circuit remains LOW.

When The trigger Signal returns HIGH again, The output from the first NOT gate goes LOW to logic '0' and The fully charged capacitor starts to discharge itself back through the Parallel resistor connected across it. When The Voltage across The capacitor drops below the lower Threshold Value of The input to The second NOT gate, its output switches back again producing a logic level 1 at Q. The diode D1 Prevents the timing capacitor from discharging itself back through the first NOT gates output.

Then The Time constant for a NOT gate Monostable multivibrator is given as

$$T = 0.8RC + \text{Trigger in seconds.}$$

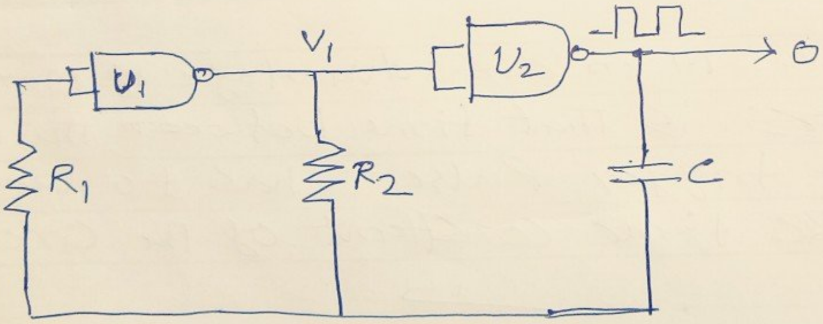
one Main disadvantage of mono-stable multivibrators is that time between the application of The Next trigger Pulse T has to be greater than the RC time constant of the circuit.

Astable Multivibrator Circuit —

Astable Multivibrators are the most commonly used type of multivibrator circuit. An astable multivibrator is a free running oscillator that have no permanent "meta" or steady state but is continually changing its O/P from one state (LOW) to another state (HIGH) and then back again. This continual switching action from "HIGH" to "LOW" and "LOW to HIGH produces a continuous and stable square wave output which switches abruptly between the two logic levels making it ideal for timing and clock pulse applications.

As with the previous monostable multivibrator circuit above, the timing cycle is determined by the RC time constant of the resistor-capacitor, RC Network. Then the output frequency can be varied by simply changing the value (s) of the resistors and capacitor in the circuit.

NAND Gate Astable Multivibrator :-



The astable multivibrator circuit uses two CMOS NOT gates such as the CD4069 or the 74HC04 hex inverter ICs. or as in our simple circuit below a pair of CMOS NAND gates such as the CD4011 or the 74LS132 as well as a RC timing network. The two NAND gates are connected as inverting NOT gates.

Suppose that initially the O/T from the ~~NAN~~ NAND gate U_2 is HIGH at logic level "1", then the input must therefore be ~~low~~ LOW at logic level "0" as will be the output from the first NAND gate U_1.. capacitor, C is connected between the output of the 2nd NAND gate U2 and its input via the timing resistor R_2. The capacitor now charges up at a rate determined by the time constant of R_2 and C.

As the capacitor C charges up the junction between the resistor R_2 and and capacitor C, which is also connected to the ~~point~~ input of the NAND gate U_1 via the stabilising resistor, R_2 decreases until the lower threshold value of U_1 is reached. At this point U1 changes state and the output of U_1 now becomes HIGH. This change causes NAND gate U_2 to also change state as its input has now changed from a logic "0" to a logic "1" condition resulting in the output of NAND gate U_2 becoming LOW.

Capacitor C is now becomes reverse biased so starts to discharge itself through the input of U_1. capacitor C charges up again in the opposite direction determined by the time constant of both R_2 and C as before until it reaches the upper Threshold Value of NAND gate U1. This causes U1 to change state and the cycle repeats itself over again.

Then, the time constant for a NAND gate Astable Multivibrator is given as $T = 2.2RC$ in seconds with the output frequency given as $f = 1/T$.

For example, if the resistor $R_2 = 10K\Omega$ and the capacitor $C = 45nF$, the oscillation frequency of the circuit would be given as –

$$f = \frac{1}{T} = \frac{1}{2.2RC} = \frac{1}{2.2 \times 10K\Omega \times 45nF} = 1KHz$$

Then the output frequency is calculated as being 1KHz, which equates to a time constant of 1ms. Thus the output waveform would look something like this.