**ABSTRACT**

**Design and implement asynchronous MOD 10 counter using JK Flip Flops**

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**Theory:-**

“Asynchronous counter” is a counter circuit, which created from the series of J-K flip-flops. The clock signal will be given to the clock input of the first J-K flip-flop then the output of the first J-K flip-flop will connect to the input of the adjacent flip-flop. The output signal, which represents the current binary counting value, is the output signal ( *Q* ) of all J-K flip-flop. While the output ( *Q* ) of the first J-K flip-flop is the least significant bit (LSB) of the binary value.

The maximum number of counting value depends on the number of J-K flip-flops in the circuit. For example, the 4 bits counter is composed of 4 J-K flip-flops. This maximum number, which this counter can count, is 24 = 16. Hence, this counter can count from 0 to 15.

If the output ( *Q* ) of the first J-K flip-flop is connected to the clock input of the adjacent J-K flip-flop, this counter will be the count-up counter. For example, the connecting of flip-flops in Fig. 1 is “4-bits count-up asynchronous counter”.



J *Q*

SET

K *Q*

CLR

J *Q*

SET

K *Q*

CLR

J *Q*

SET

K *Q*

CLR

J *Q*

SET

K *Q*

CLR

However, if the output ( *Q* ) of the first J-K flip-flop is connected to the clock input of the adjacent J-K flip-flop, this counter will be the count-down counter, as shown in Fig.

J *Q*

SET

K *Q*

CLR

J *Q*

SET

K *Q*

CLR

J *Q*

SET

K *Q*

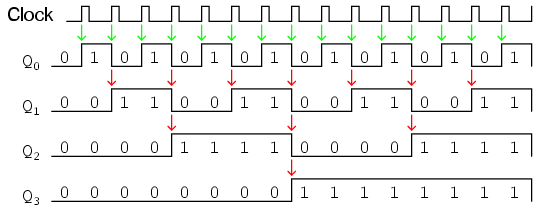
CLR

J *Q*

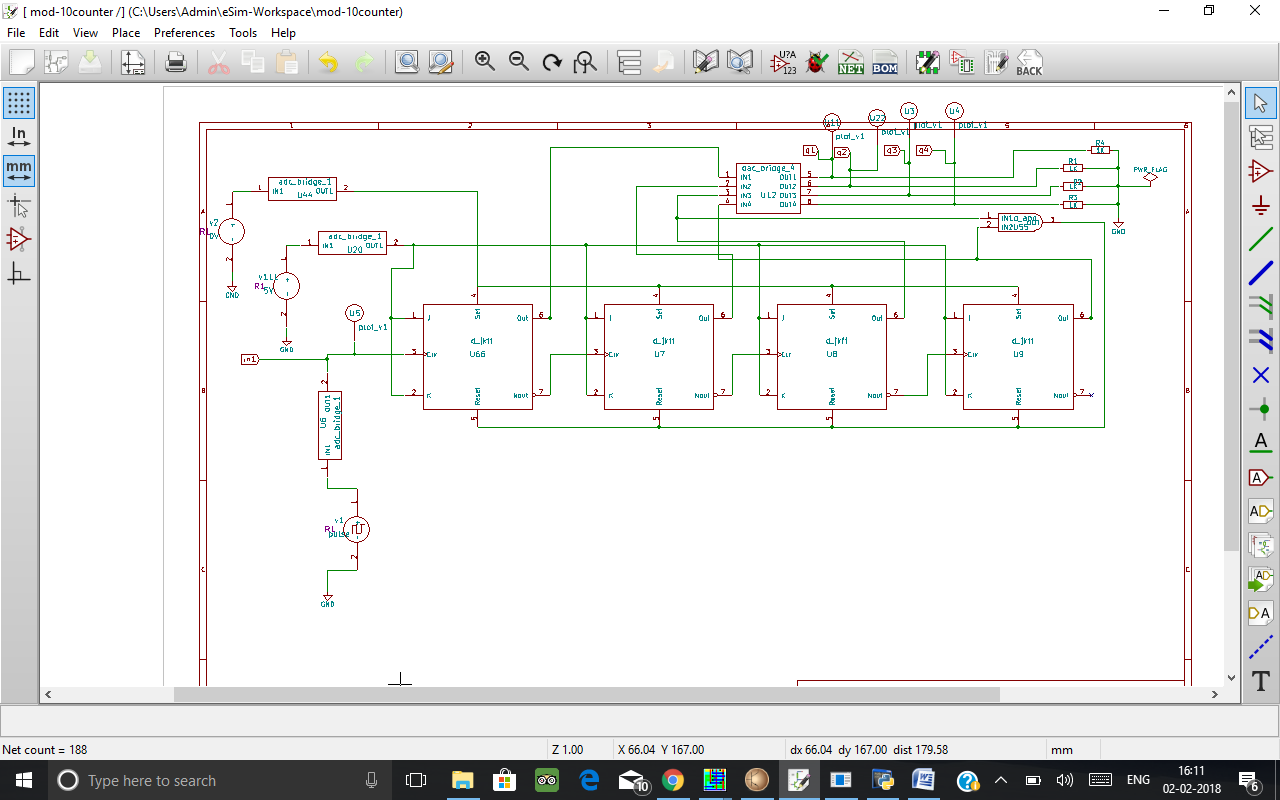
SET

K *Q*

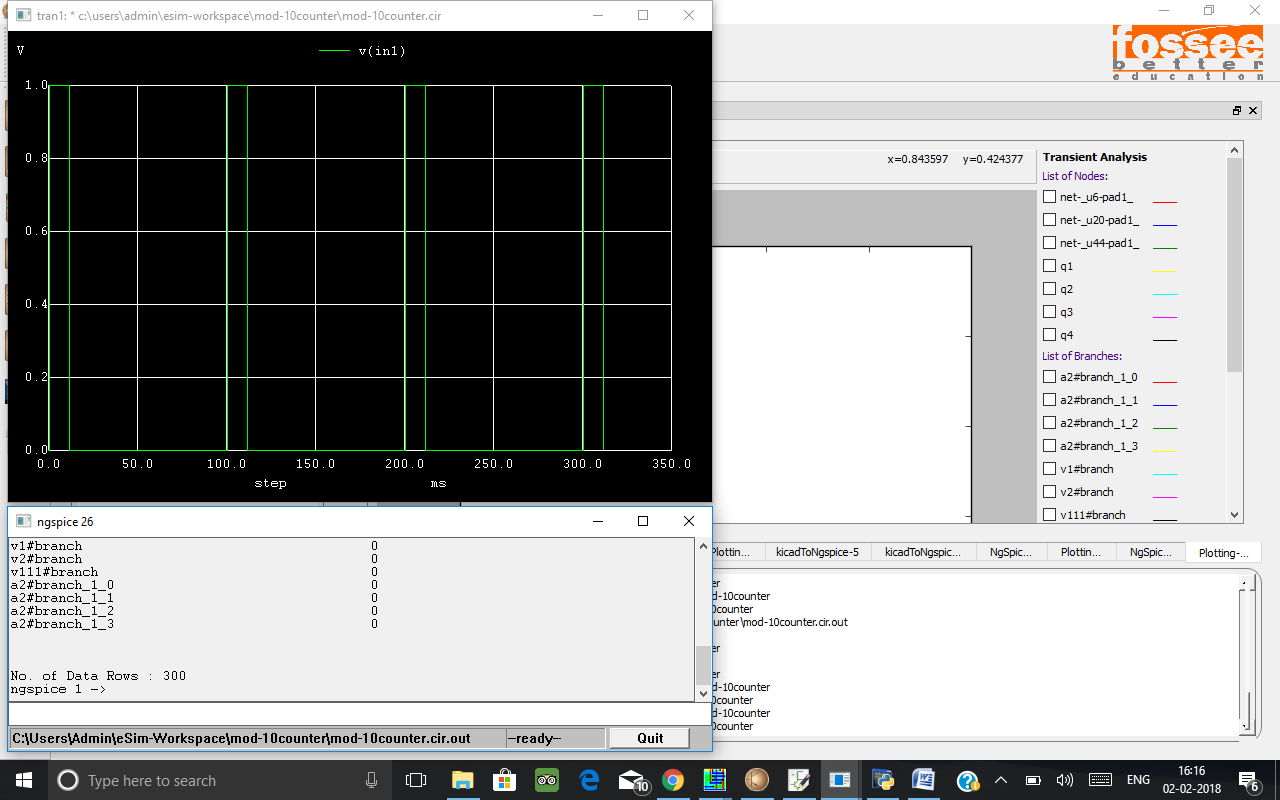
CLR



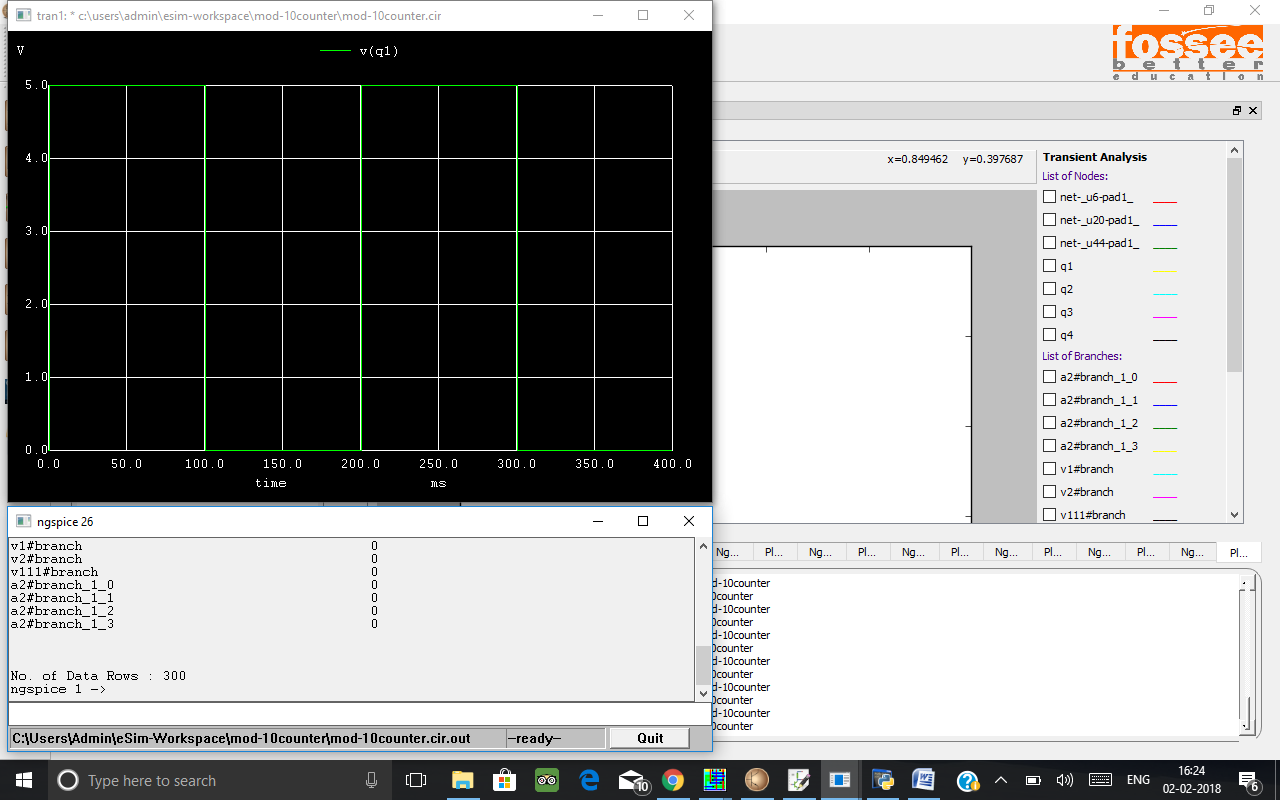
**Design**



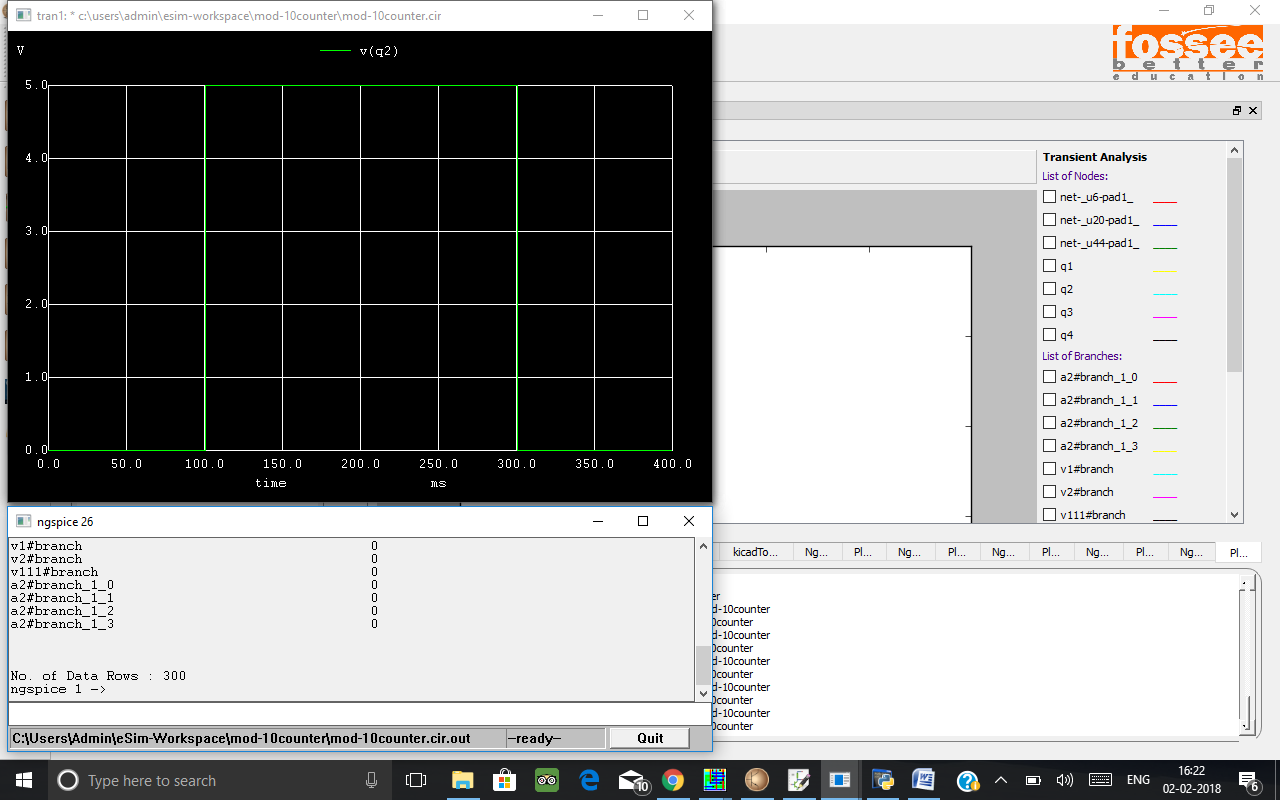
[This is the circuit of MOD 10 asynchronous counter used for simulation using esim]



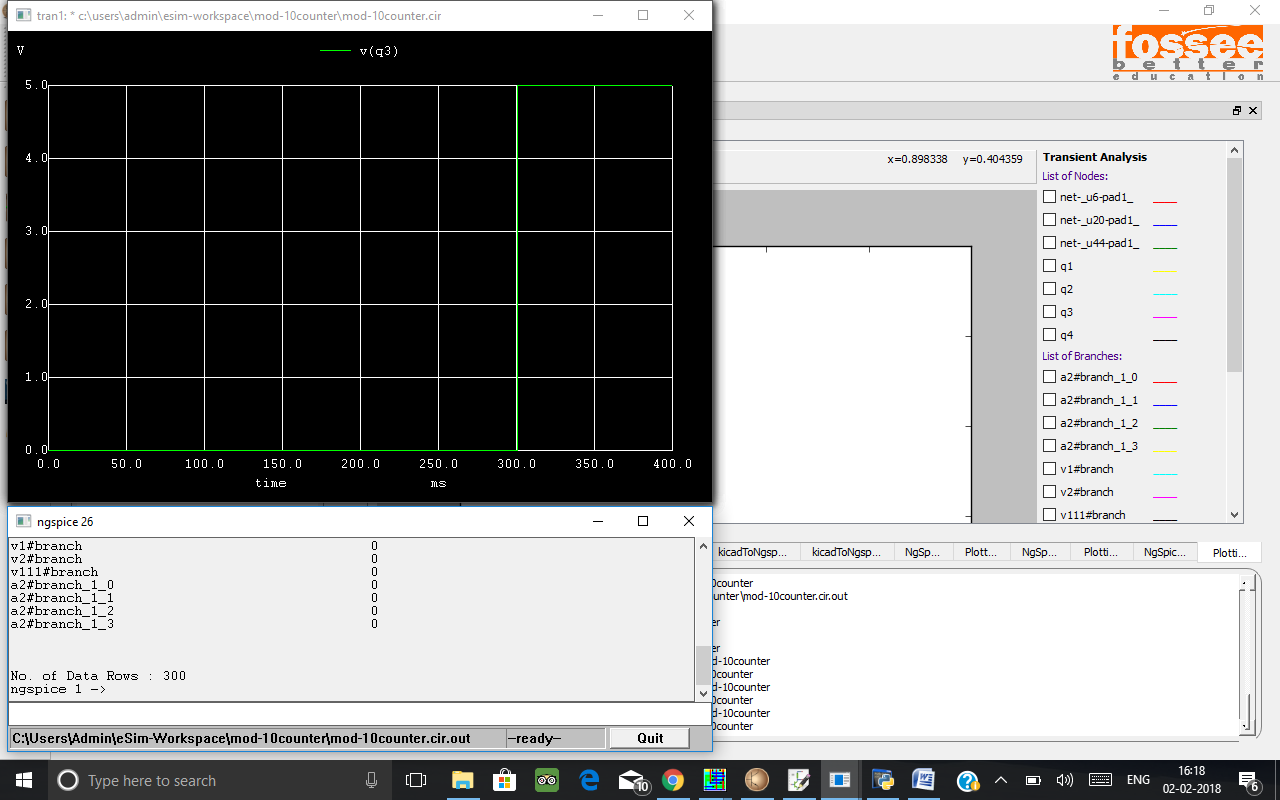
[NG spice Input Waveform ]



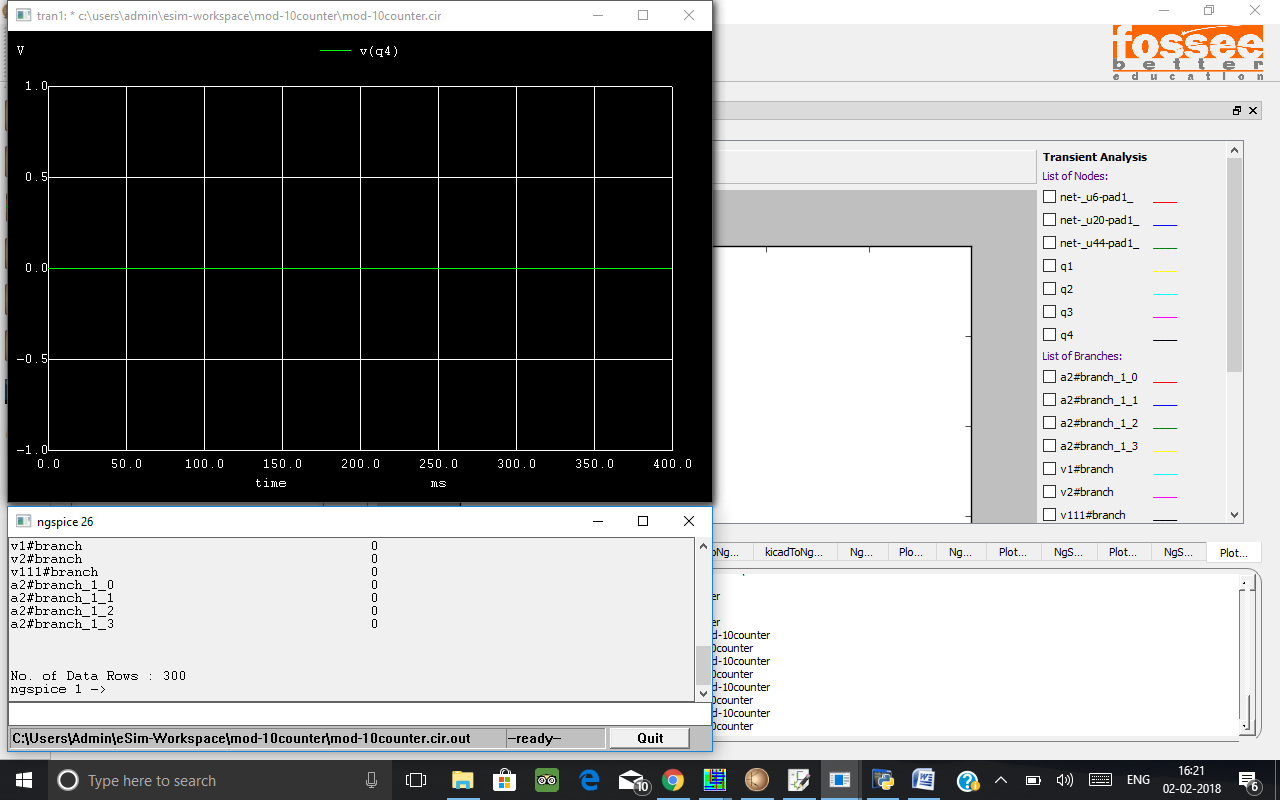
[NG spice output plot of q1]



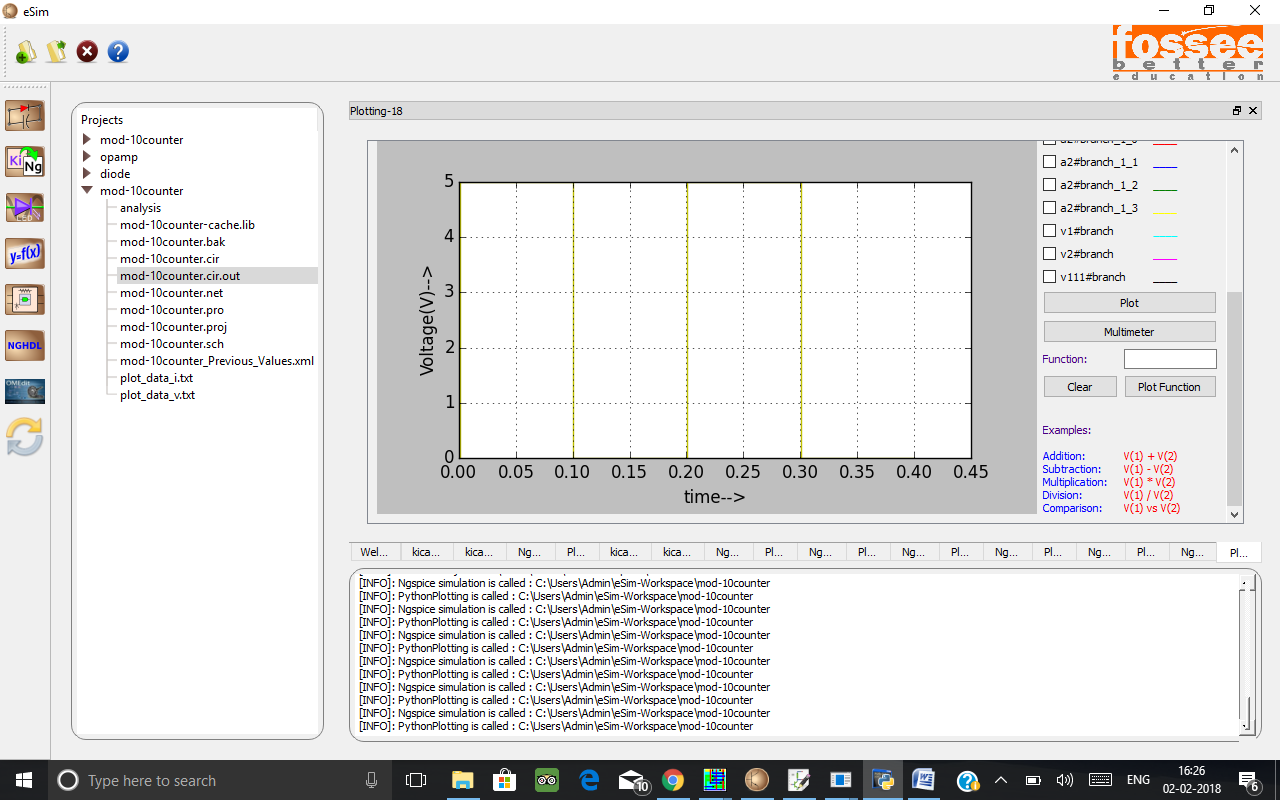
[NG spice output plot q2]



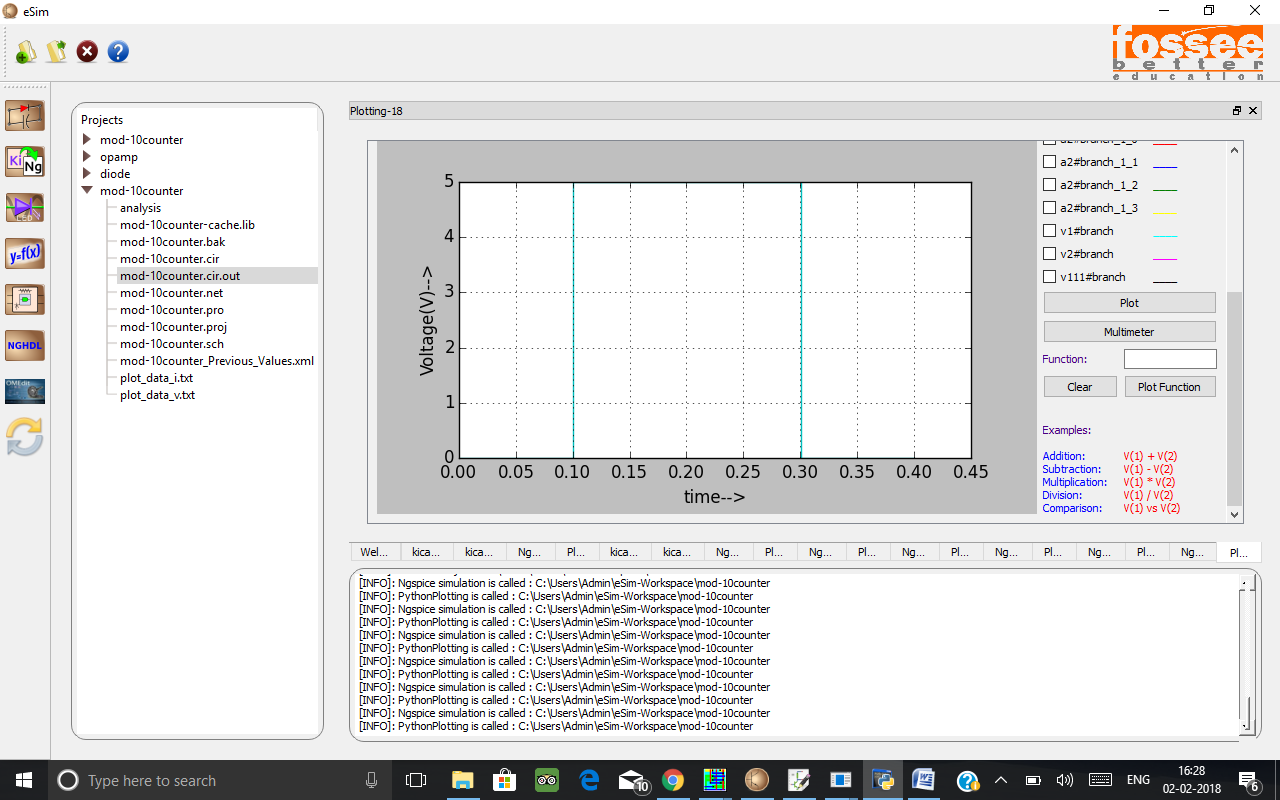
[NG spice output plot q3]



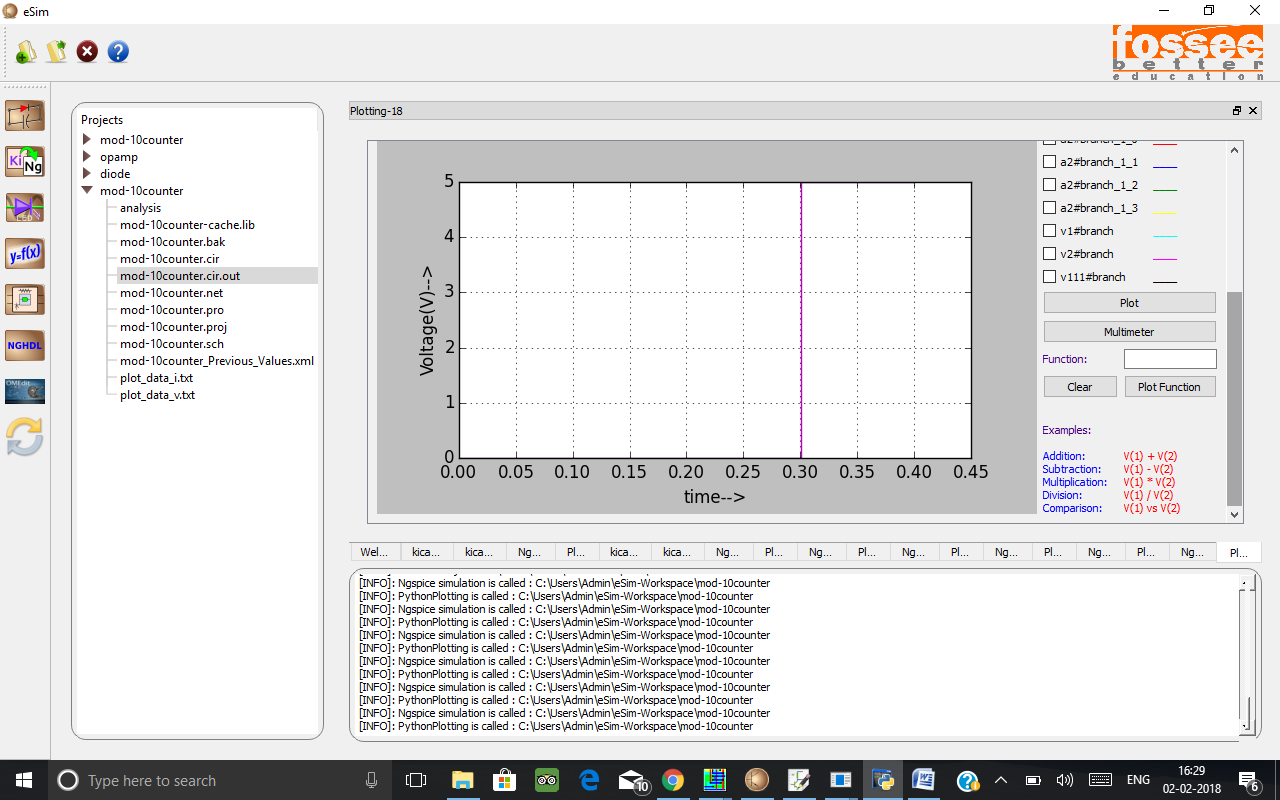
[NG spice output plot q4]



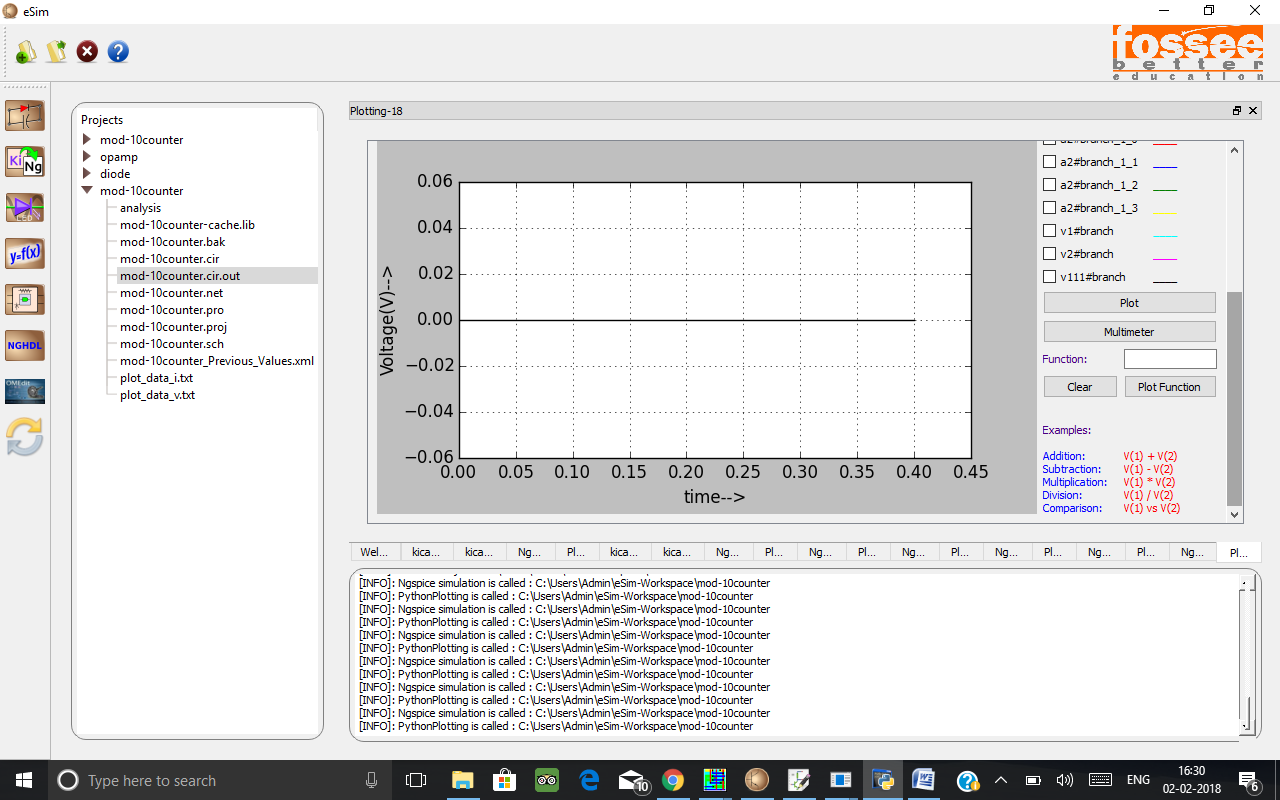
[Python plot of q1]



[Python plot of q2]



[Python plot of q3]



[Python plot of q4]

Reference:

1. -<http://elektronika-dasar.web.id/asynchronous-bcd-decade-counter/>.