PLAZA, ELMO L.
BSCPE 3A

VHDL CODE FOR T FLIP FLOP:

Clear	T	Clock	Qn+1	$\overline{Qn+1}$
1	0	0	0	$\overline{Qn}$
0	1	⎍	$\overline{Qn}$	Qn

```
library IEEE;
use IEEE.STD_LOGIC_1164.ALL;
use IEEE.STD_LOGIC_ARITH.ALL;
use IEEE.STD_LOGIC_UNSIGNED.ALL;

entity T_flipflop is
   Port ( t    : in  STD_LOGIC;    -- T input
          clk  : in  STD_LOGIC;    -- Clock input
          rst  : in  STD_LOGIC;    -- Active-low reset
          q    : buffer STD_LOGIC   -- Output (buffer allows reading and writing)
   );
end T_flipflop;

architecture Behavioral of T_flipflop is
   signal div   : std_logic_vector(22 downto 0) := (others => '0'); -- Clock divider counter
   signal clkd  : std_logic;  -- Divided clock
begin

   -- Clock divider: Slow down the clock
   process(clk)
   begin
      if rising_edge(clk) then
         div <= div + 1;
      end if;
   end process;

   -- Select the slower clock signal
   clkd <= div(20);  -- You can adjust this value for more or less division

   -- T flip-flop behavior
   process(clkd, rst)
   begin
      if rst = '0' then       -- Active-low reset
         q <= '0';          -- Reset output to '0'
      elsif rising_edge(clkd) then
         if t = '1' then      -- Toggle on T=1
            q <= not q;      -- Toggle the output
         end if;
      end if;
   end process;

end Behavioral;
```

🔁 Behavior of a T Flip-Flop

T	Clock Edge	Q (LED)	What Happens
0	↑ (rising)	Holds last state	No toggle
1	↑ (rising)	Toggles	Changes from 0→1 or 1→0

So if:

- You're feeding in a **slow divided clock**,
- Your LED is connected to **Q**,
- And you **press the T button to make** `T='1'`, then:

The LED will **toggle (flip)** on each clock rising edge **only if** `T=1` at that moment.

- The LED is toggling **only when you press T**, and depending on **when** you press it (relative to the clock edge), the LED either turns **on or off**.
- This is **normal and expected** behavior for a T flip-flop.

🎯 Why It Feels Random:

Because of the clock speed and your **human reaction time**, sometimes:

- You press T **just before** a rising clock edge → it toggles.
- You press T **just after** a rising clock edge → no effect (waits for next one).

This causes the LED to **sometimes turn on, sometimes off**, depending on the **timing**.