DAY 4-111 DAYS VERIFICATION CHALLENGE

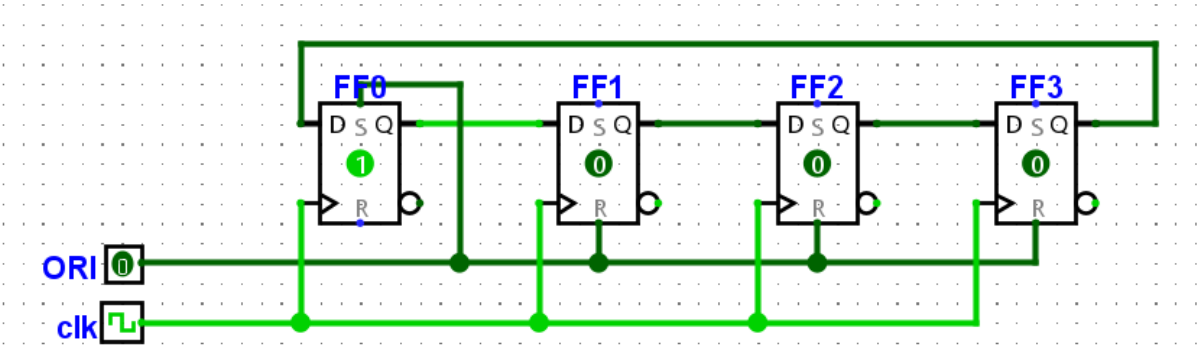
Topic: Counters, Timers

Skill: Digital Electronics

DAY 4 CHALLENGE:

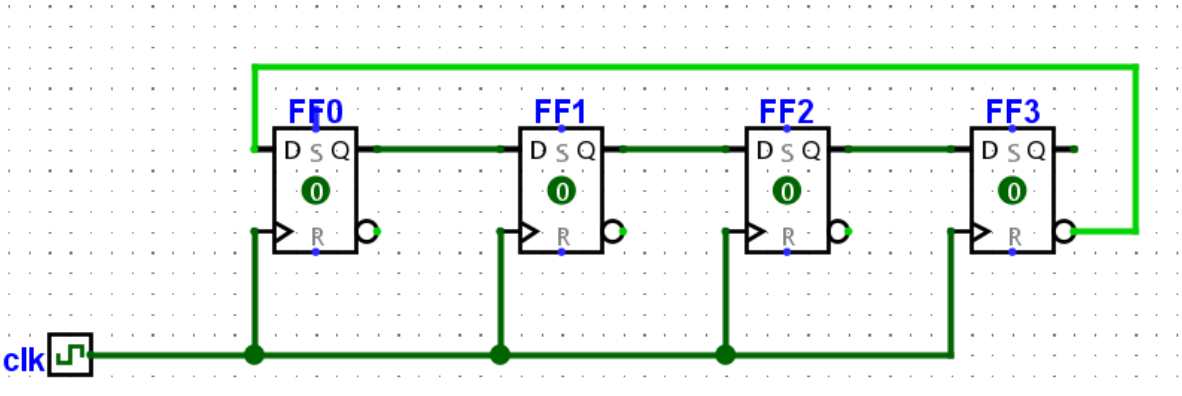
1. Design & explain working of:

a. 4-bit Ring counter



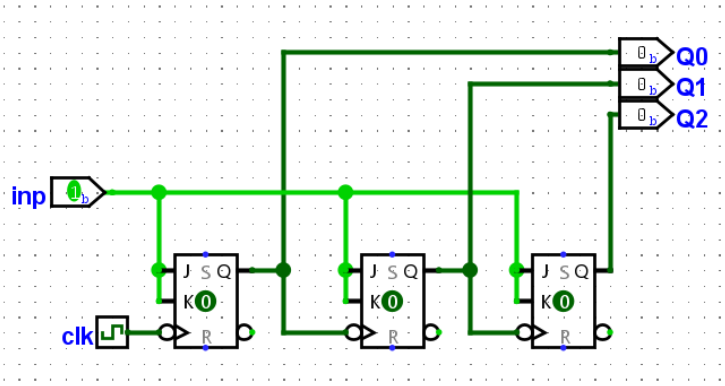
ORI	Clock	Q0	Q1	Q2	Q3
1	↑	1	0	0	0
0	↑	0	1	0	0
0	↑	0	0	1	0
0	↑	0	0	0	1
0	↑	1	0	0	0

b. 4-bit Johnson counter



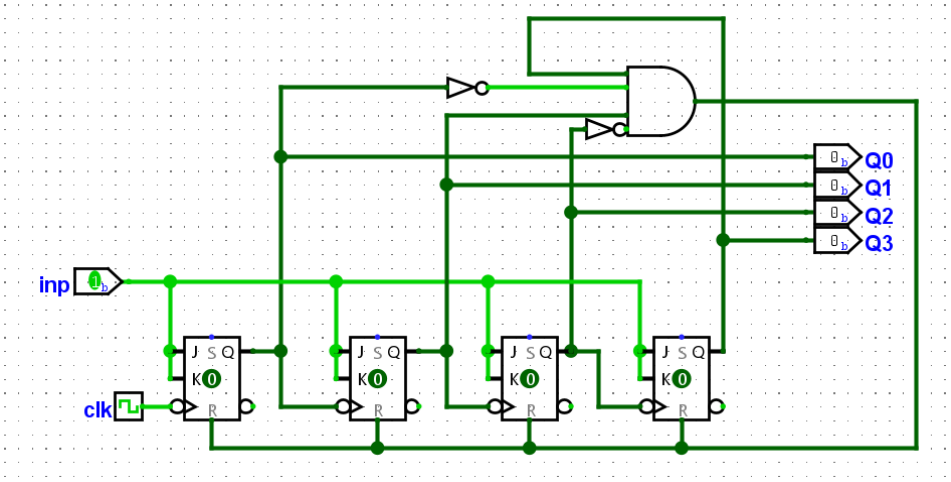
CP No.	Q0	Q1	Q2	Q3
0	0	0	0	0
1	1	0	0	0
2	1	1	0	0
3	1	1	1	0
4	1	1	1	1
5	0	1	1	1
6	0	0	1	1
7	0	0	0	1
8	0	0	0	0

c. 3-bit Ripple counter



Input	Clock	Q0	Q1	Q2
1	↓	0	0	0
1	↓	0	0	1
1	↓	0	1	0
1	↓	0	1	1
1	↓	1	0	0
1	↓	1	0	1
1	↓	1	1	0
1	↓	1	1	1
1	↓		0	0

d. Decade counter



Input pulses	Q3	Q2	Q1	Q0
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1(reset)
0	0	0	0	0

2. List the difference between:

a. Timers & Counters

Timers

- **Purpose:** Measure time intervals or generate delays.
- **Input:** Clock signal.
- **Operation:** Count clock pulses, trigger event at set count.
- **Modes:** Up-counting, down-counting, up/down-counting.
- **Applications:** Delays, periodic interrupts, PWM generation, event scheduling.
- **Examples:** Wait 1 second, generate periodic signals.
- **Commonalities:** Similar hardware and configuration as counters.

Counters

- **Purpose:** Count external events or pulses.
- **Input:** External signal (e.g., sensor pulses).
- **Operation:** Increment/decrement value per input pulse.
- **Modes:** Count up, count down, bidirectional counting.
- **Applications:** Event counting, frequency measurement, position tracking.

- **Examples:** Count items on conveyor, measure speed, track motor position.
- **Commonalities:** Similar hardware and configuration as timers.

b. Synchronous & Asynchronous Counter

Synchronous Counter

- **Clock Signal**: All flip-flops receive the same clock signal simultaneously.
- **Speed**: Faster operation due to simultaneous triggering.
- **Design**: More complex to design due to the need for simultaneous triggering.
- **Propagation Delay**: Lower as all flip-flops change states together.

Asynchronous Counter

- **Clock Signal**: Flip-flops are triggered in a chain, with each flip-flop's output clocking the next.
- **Speed**: Slower due to sequential triggering.
- **Design**: Simpler to design because flip-flops are chained.
- **Propagation Delay**: Higher due to the ripple effect through the flip-flops.

3. Explain working of 555 Timer IC

The 555 Timer IC is a versatile and widely used integrated circuit for timing and oscillator applications. It operates in three modes: astable, monostable, and bistable

Pin Configuration

1. **GND (Pin 1)**: Ground.
2. **VCC (Pin 8)**: Supply voltage (typically 5V to 15V).
3. **Trigger (Pin 2)**: Starts the timing interval when voltage drops below 1/3 VCC.
4. **Output (Pin 3)**: Provides the timing pulse.
5. **Reset (Pin 4)**: Resets the timing interval when held low.
6. **Control Voltage (Pin 5)**: Modifies the threshold voltage (usually connected to ground via a capacitor).
7. **Threshold (Pin 6)**: Ends the timing interval when voltage exceeds 2/3 VCC.
8. **Discharge (Pin 7)**: Discharges the timing capacitor.

In astable mode, it generates a continuous square wave output by repeatedly charging and discharging a capacitor through resistors. In monostable mode, it produces a single output pulse of a duration determined by external resistor and capacitor values when triggered. In bistable mode, it functions as a flip-flop, toggling between high and low states when triggered by input signals. The 555 Timer's ease of use and configurability make it suitable for a wide range of applications, including timers, pulse generation, and oscillators.