

## LAB 15: SHIFT REGISTER

### 1 Goals

- Understand the working principle of shift registers.
- Build 4-bit shift registers using D flip flops.

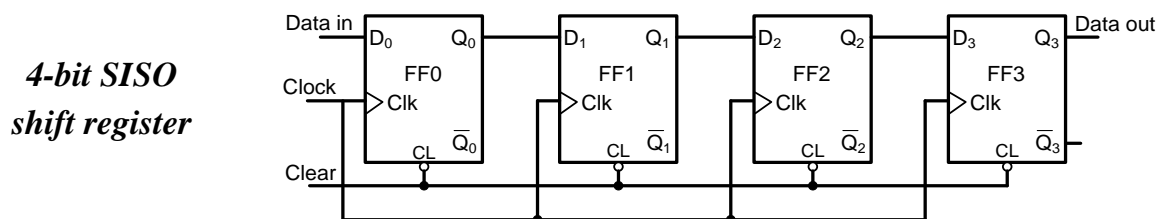
### 2 Shift Register

A *shift register* is a digital circuit used to store and transfer data. It creates an important link between the main system (e.g., microprocessors) and I/O channels. Based on the method to write data onto or read data from shift registers, there are 4 types of shift registers: **SISO** (*serial-in serial-out*), **SIPO** (*serial-in parallel-out*), **PISO** (*parallel-in serial-out*), **PIPO** (*parallel-in parallel-out*).

### 3 Exercises

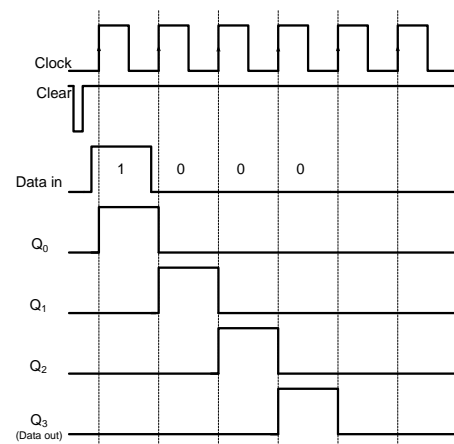
#### 3.1. 4-bit SISO

Implement the following 4-bit SISO shift register using 4 D flip flops. All the flip flops respond to the rising-edge of the clock pulse.



#### Operation:

- Data bits are serially fed into the “Data in” port ( $D_0$ ) of the register.
- The data is serially read in the “Data out” port ( $Q_3$ ).
- The “Clear” input is used to reset all the flip flops’ outputs to 0s.



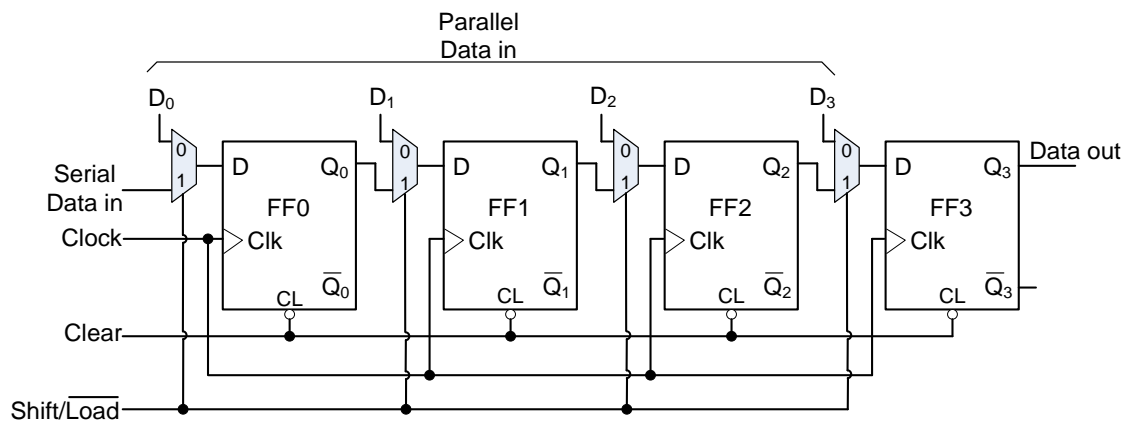
#### Requirements:

- Test all ICs and equipment.
- Use the given ICs (74HC74-D flip flop), LEDs, and resistors to assemble the shift register on a breadboard.
- Use switches (or buttons) to generate the Data In and Clear signal.
- Use a switch (or button or function generator) to generate the Clock signal.
- Supply 5V/GND power to the circuit.

- Define the circuit's activities and explain its operation.
- Write comments on the experimental results.

### 3.2. 4-bit PISO

Implement the following 4-bit PISO shift register using 4 D flip flop.



**4-bit PISO shift register**

#### Operation:

- Data bits are serially fed into the “Data in” port (D<sub>0</sub>) of the register.
- The data is read in parallel in the “Data out” port (Q<sub>3</sub> Q<sub>2</sub> Q<sub>1</sub> Q<sub>0</sub>).
- The “Clear” input is used to reset all the flip flops’ outputs to 0s.

#### Requirements:

- Test all ICs and equipment.
- Use the given ICs (74HC74-D flip flop), LEDs, and resistors to assemble the shift register on a breadboard.
- Use switches (or buttons) to generate the Data In and Clear signal.
- Use a switch (or button or function generator) to generate the Clock signal.
- Supply 5V/GND power to the circuit.
- Define the circuit's activities and explain its operation.
- Write comments on the experimental results.

Components/Equipment	Description	Quantity
74HC74	2x D flip flop	2
74LS157	4x 2-bit 2-to-1 MUX	1
Resistor	330Ω	Few
LED		Few
Buttons (or switches) for “Data in”, “Clock”, “Clear” inputs		Few
Breadboard		1
Connecting Wires		Few
Multimeter/Power Supply		1/1