

Hardware Design Lab **(Experiments and Plan of Execution)**

Experiments

- 1. Design a frequency generator with a 555 timer for 1 Hz. (1c)**
2. Design an up/down Decade counter using integrated chips (IC 74192 with control of up/down bit OR IC 74190). Integrate to design a system that counts up/down 0-99 counter (**2c**)
3. Design a stopwatch by cascading two counters (IC 74192) to form a down counter from a <2-digit set number> to 0. The <2-digit set number> will be set using a register, IC 74194. (**2c**)
4. Design a system that counts the number of people getting in and out of a room. Assume that the maximum number of people who can be accommodated in a room is 9 and a person can go in or out of the room at any time. Two sensors are attached which individually can sense the person going in/out of the room. You can emulate sensors using two SPST (“Single Pole Single Throw”) push-button switches. (**2c**)
5. Emulate a simple 3-crossing traffic signal system using the 0-9 counter as a timer. Note: The crossings will have different time sets, during which the cars can cross. Design the system by forming your own rules, giving allowance for emergency services across the crossings. (**3c**)
6. Design a 4-bit calculator for two 4-bit numbers. The numbers can be directly loaded to the inputs; the user should be able to compare the two numbers, add, subtract and multiply. (Use IC 7483, 74151, 7484, 74194, 74192) (**3c**)
7. Remove the control part and the counters with an Arduino Uno Board to emulate the traffic signal system.

Note

- Experiment number 1 is compulsory and will be required to be done in the beginning of the lab.
- All experiments should have reported with simulations using SimulIDE (<https://www.simulide.com/p/home.html>)
- Please come prepared with the design of the experiments as you are assigned to the lab, so that you can fabricate the circuit immediately.
- All the experiments are given a time limit for completing by 1 class(c), 2 class or 3 classes.
- For all the experiments, you will be provided with 7-segment displays with their respective drivers.
- The switches which are to be used are SPST switches. Read the following articles related to switches.

- <https://www.microswitchsupplier.com/blog/spdt-switch.html>
 - <https://electronicsclub.info/switches.htm>
 - <https://www.digikey.com/en/articles/how-to-implement-hardware-debounce-for-switches-and-relays>
 - <https://circuitcellar.com/research-design-hub/design-solutions/how-to-eliminate-switch-bounce/>
- Groups of 3 students will be formed
- Evaluation Parameters:
 - **Continuous Evaluation :** Each experiment (simulation and hardware development) will be evaluated by the faculties individually
 - Marks will be given for attendance
 - An end-semester examination will be taken, where each student will be evaluated based on an experiment given to them. The experiments are to be simulated on SimuliIDE or they might be given to implement the experiment on a hardware board.

Note: The experiments might not be the same as those given in the class.

The available chips in the lab are:

74192	Up/Down BCD Decade Counter
74190	Up/Down BCD Decade Counter
74173	D- FlipFlop
74151	Multiplexer
74194	4 bit bidirectional shift registers

7447	(BCD TO 7-SEGMENT DECODER DRIVER)
7448	(BCD TO 7-SEGMENT DECODER DRIVER)
SP 5503	7 segment display
SP 5501	7 segment display
7476	J K Flip-Flop
7486	2-i/p XOR
7400	2-i/p NAND
7420	Dual 4-Input NAND Gate.

7408	2-input positive AND gate
7432	Quad 2-Input OR
7421	4 i/p AND gate
74138	Decoder/Demultiplexer
74153	DUAL 4-INPUT MULTIPLEXER
7473	J K Flip-Flop
74151	Multiplexer
555	Timer