**ECE 329**

**Digital Circuit Design II+Lab.**

**Fall 2018/2019**

**LAB # 3**

8**.10.2018**

**Objective:**

To learn about asynchronous counters

1. **Using T Flip Flops in Design**
2. **Using JK Flip Flops in design**
3. **MOD-N counters (Flip Flops with reset pins)**
4. **7493A Integrated Cicuits**
5. **Propagation Delay**
6. **Design a 3 bits counter by using T Flip Flops (**10 Points**)**

**Procedure:**

1. Draw the counter circuit that counts 0-7 and draw the output waves that you expect.
2. Create your circuit by using ORCAD,
3. Simulate your circuit and print the output waves.
4. Compare the simulation output with your expected output. Is there any difference, if there is explain why?
5. **Set MOD-16 Counter by using JK Flip Flops:** (20 Points)

**Procedure:**

1. Draw the counter circuit that counts 0-15 and draw the output waves that you expect.
2. Create your circuit by using ORCAD,
3. Simulate your circuit and print the output waves.
4. Compare the simulation output with your expected output. Is there any difference, if there is explain why?
5. **Modify MOD-16 Counter of Part 1 to MOD-10 Counter:** (30 Points)

**Procedure:**

1. Modify the MOD-16 counter circuits to get MOD-10 counter (namely Decade Counter) and draw the output waves that you expect.
2. Create your circuit by using ORCAD,
3. Simulate your circuit and print the output waves.
4. Compare the simulation output with your expected output. Is there any difference, if there is explain why?
5. **7493A:** (40 Points)

**Procedure:**

1. Study inner circuit of 7493A.
2. Use 7493A works as MOD-8 and MOD-16 counters,
3. Simulate your circuits and print the output waves.
4. Now, by using 7493A, design a counter that counts in decimal up to 70.

(0,1,2,……,69,70,0,1,….). How many IC you need?