Digital Logic and Computer Systems

EEL 3701C **Midterm Exam** **Friday, October 30, 2020**

08:20 PM – 10:20 PM

Name: ___________________________________

Student ID: ______________________________

Location: Zoom
https://ufl.zoom.us/j/92232023106?pwd=M0hhZERuWVFsanFYeXg0dmVOcDZFUT09

Rules for the exam

1. **Be in zoom** the entire time with your camera on but mic muted. If possible, please be alone in a quiet room with no distractions.
2. You will be placed in a breakout room with a randomly selected PI. If you have a question, please send a direct message to the PI in your room.
3. **Open note and open internet** (including canvas!)
4. However, communication with others is **strictly prohibited**. This includes but is not limited to text, IM (such as Discord, Snapchat, Facebook, etc.), email, voice chat, etc. Violations of this will be treated as a violation of the UF Academic Policy.
5. You **may complete the exam in any way** that best suits you. You can print out the exam and write on it, you can use notebook paper, you can use a tablet+stylus on your computer, whatever works. Please **clearly mark each problem** in your submission.
6. You are allotted an **extra 15 minutes** on the due date for printing, scanning, and any technical issues. However, **do not use this as extra time**. You are expected to stop working at 10:20pm.
7. **Show all work**!!
8. When scanning, please make sure that **all answers are legible** and clear in the photos. This does not have to apply for work you do, but we do give **partial credit** for correct work so keep that in mind.
9. Please keep all truth tables in **counting order**

On my honor, I have neither given nor received unauthorized aid in doing this assignment.

Signature: ______________________________

Problem 1	Problem 2	Problem 3	Total
/31	/15	/15	/61, %

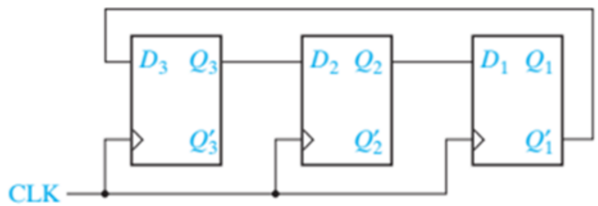
Problem #1 (General Understanding, 35 pts)

1) What is the difference between combinational and sequential circuits? **(1 pts)**

2) Why are binary numbers used in digital systems, as opposed to other bases? **(1 pts)**

3) In digital systems, why are 1's Complement and 2's Complement commonly used to represent negative numbers instead of signed magnitude? **(1 pts)**

4) The following figure shows a 3-bit end-around shift register with the Q1′ output from the last flip-flop fed back into the D input of the first flip-flop. For example, if the initial state of the flip flop is 000, then the next state will be 100.

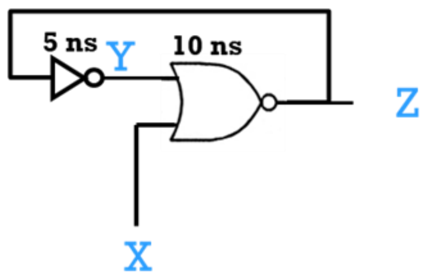


Provide the next three successive states (D3D2D1) of the shift register assuming a starting point of 100. **(3 pt)**

5) We wish to develop an analog controller for a safety relief valves for thermal, hydraulic, and domestic water systems. We will use the CalfiT 311 series that outputs the following values in bar: {1.5, 2, 2.5, 3, 3.5, 4, 5, 5.5, 6, 7, 8, 9} bar. Note that bar is a unit for pressure.

Create a viable binary encoding of the output values by creating a table with the bar value in one column and its encoded binary representation in the other. Then, explain why you chose this encoding in 1-2 sentences. **(5 pt)**

6) Draw a timing diagram for the circuit following circuit, showing X, Y, and Z. Assume that X is initially 0, and Y is initially 1., after After 10 ns X becomes 1 for 80 ns, and then X is 0 again. Use the gate propagation delays shown in the diagram. **(6 pts)?**



7) Do the following operation in binary **23.15 + 31.11**.
Limit your fractional decimal conversion to <u>4 digits</u> after the decimal point. **(6 pts)**

8) Do the following conversions

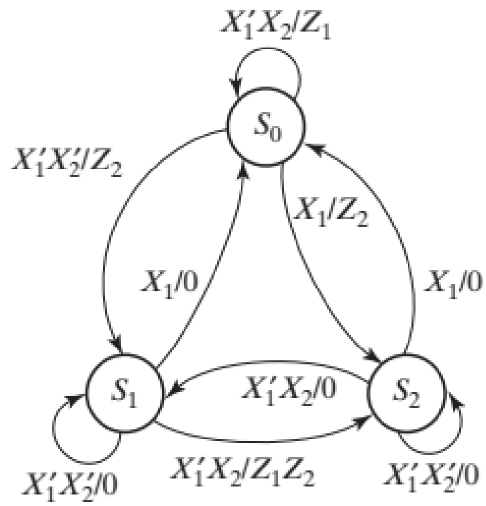
a) 478_9 to XXX_{11} **(5 pts)**

b) 56789_{16} to X_{64} (Note: A base-64 table is provided on the last page of this exam) **(3 pts)**

Problem #2 (Counters, 15 pts)

Create a 3-bit counter using a JK-FF for the least significant bit, an SR-FF for the middle bit, and a D-FF for the most significant bit. The counter should follow the sequence $\mathbf{1 \rightarrow 3 \rightarrow 2 \rightarrow 6 \rightarrow 7 \rightarrow 5 \rightarrow 1.}$ For any values **not defined** in the sequence, the next value does not matter.

Problem #3 (Automata and Control Path, 15 pts)
Given an automaton represented through the following state transition diagram



a) Devise the state transition table of the automaton **(5 pt)**

b) Convert the automaton into its Moore equivalent **(10 pts)**

Base-64 Conversion Table

For **10b**

Dec	Hex	Base-64	Dec	Hex	Base-64
0	00	0	32	20	W
1	01	1	33	21	X
2	02	2	34	22	Y
3	03	3	35	23	Z
4	04	4	36	24	a
5	05	5	37	25	b
6	06	6	38	26	c
7	07	7	39	27	d
8	08	8	40	28	e
9	09	9	41	29	f
10	0A	A	42	2A	g
11	0B	B	43	2B	h
12	0C	C	44	2C	i
13	0D	D	45	2D	j
14	0E	E	46	2E	k
15	0F	F	47	2F	l
16	10	G	48	30	m
17	11	H	49	31	n
18	12	I	50	32	o
19	13	J	51	33	p
20	14	K	52	34	q
21	15	L	53	35	r
22	16	M	54	36	s
23	17	N	55	37	t
24	18	O	56	38	u
25	19	P	57	39	v
26	1A	Q	58	3A	w
27	1B	R	59	3B	x
28	1C	S	60	3C	y
29	1D	T	61	3D	z
30	1E	U	62	3E	#
31	1F	V	63	3F	%

Table 1 – Base-64 conversion table. Note: Base-64 is case sensitive!