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
/35	/15	/15	/65, %

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) Show that the NOR gate is a universal gate **(2 pts)**

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

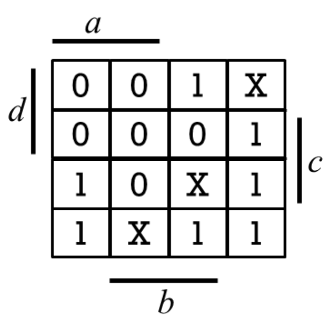
5) What is meant by overflow? How can you tell that an overflow has occurred when performing addition in 1's or 2's complement? **(1 pts)**

6) Using **only** NAND gates, draw a circuit for $\mathbf{F} = \neg(\overline{\mathbf{A}}(\overline{\mathbf{BC}}))$ **(2 pts)**

7) 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)**

8) Consider a Boolean function F represented through the following Karnaugh Map. Note: X’s are don’t cares.



a. List all the prime implicants of F **(2 pts)**

b. List all non-essential prime implicants **(2 pts)**

c. Provide the minimum SOP for F **(2 pts)**

d. Provide the minimum POS for F **(2 pts)**

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

10) Do the following conversions

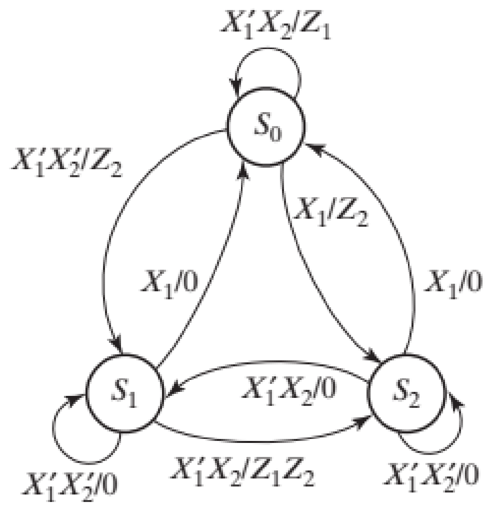
a) 478_9 to XXX_{11} **(5 pts)**

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 <u>does not matter</u>.

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!