UOttawa ITI1100X Summer 2016
Digital Systems I

Professor Qi Hao

Final Answers to Midterm Examination

This document is for the internal use only for the students of ITI 1100X summer 2016, University of Ottawa. Further distribution or reproduction is strictly prohibited.

Answer to Question 1 (Total 40 points)

(a) Convert the following numbers from one radix to another. Show your work. [20]

(i)

A = 13.25				Fraction		
Integer						
	/2	Rem			X 2	
13	6	1		0.25	0.5	0
6	3	0		0.5	0	1
3	1	1				
1	0	1				
A = 1101.01_2						

(ii)

Separate bits in groups of 4:
$$10.11111 = 0010.1111\ 1000$$
Convert each group into hexadecimal equivalents: $2.F8_{16}$

(iii)

A = 8.04				Fraction		
Integer						
	/5	Rem			X 5	
8	1	3		0.04	0.2	0
1	0	1		0.2	0.0	1
A = 13.01_5						

(b) [10]

8 bits to represent unsigned binary numbers.   A= $(110101)_2$ and B= $(10001101)_2$.

A	00110101	
$[A]_2$	11001011	
B	10001101	
Sum=B+$[A]_2$	101011000	End carry produced
Result	$(1011000)_2$	End carry discarded. Positive value
Result in signed magnitude	0_1011000	
Result in decimal	$(88)_{10}$	

(c) [10]

$(-17)_{10}$-$(33)_{10}$= $(-17)_{10}$+$(-33)_{10}$		
+17	0_0010001	
-17 in signd 2's comp.	1_1101111	
+33	0_0100001	
-33 in signed 2's comp.	1_1011111	
-17 in signd 2's comp.	1_1101111	
Sum= (-17)+(-33)	11_1001110	End carry
Results in signed 2's comp.	1_1001110	End carry discarded. Negative value.
Results	-(110010)	
Results in signed magnitude	1_0110010	
Results in decimal	$-(50)_{10}$	

Answers to Question 2 (Total 30 points)

$$F(A,B,C,D) = \sum m(0,7,8,12) + \sum d(2,3,4,10,13)$$

(i)

AB\CD	00	01	11	10
00	m_0 1	xm_1 0	m_3 X	m_2 X
01	m_4 X	m_5 0	m_7 1	m_6 0
11	m_{12} 1	m_{13} X	m_{15} 0	m_{14} 0
10	m_8 1	m_9 0	m_{11} 0	m_{10} X

$$F = C'D' + A'CD.$$

(ii)

AB\CD	00	01	11	10
00	m_0 1	m_1 0	m_3 X	m_2 X
01	m_4 X	m_5 0	m_7 1	m_6 0
11	m_{12} 1	m_{13} X	m_{15} 0	m_{14} 0
10	m_8 1	m_9 0	m_{11} 0	m_{10} X

$$F' = C'D + CD' + AD \qquad \text{or}$$
$$F' = C'D + CD' + AC.$$
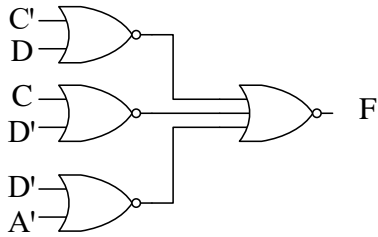$$F = (C+D')\cdot(C'+D)\cdot(A'+D')$$
$$\text{or}$$
$$F = (C+D')\cdot(C'+D)\cdot(A'+C')$$

(iii)

$$F = (C'+D)\cdot(C+D')\cdot(A'+D')$$

$$F = F'' = \left(\left((C'+D)\cdot(C+D)\cdot(A'+D)\right)'\right)'$$

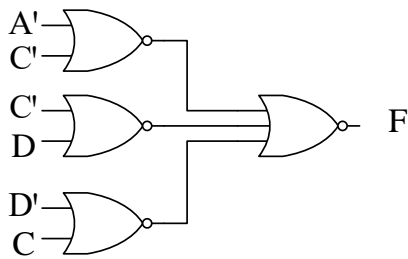$$= \left((C'+D)' + (C+D')' + (A'+D')'\right)'$$

Alternatively:

$$F = (C + D') \cdot (C' + D) \cdot (A' + C')$$

$$F = F'' = \big(\big((C'+D)(C+D') \cdot (A'+C') \big)' \big)'$$

$$= \big((C'+D)' + (C+D')' + (A'+C')' \big)$$

Answers to Question 3 (total 30 points)

(i) [10]

$$F = (A+B) * (A+c) * (A+B'+c)$$

$$= (A+B) * (A+c)$$

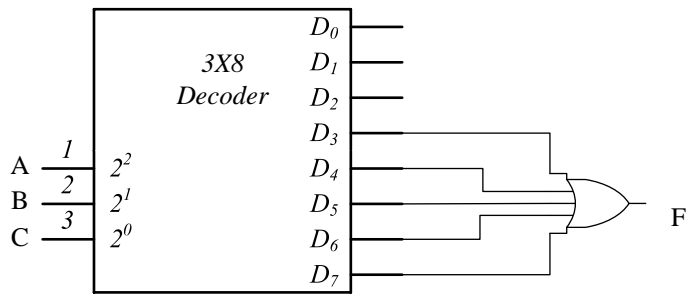$$= A + BC$$

(ii) [10]

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

(iii) [10]

Question 4* (Optional with bonus 30 points)

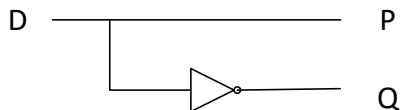*(Note: bonus marks will not bring a total mark to more than 100)*

i) [6]
 Transmitted Data

D	P	Q
0	0	1
1	1	0

ii) [6]
Logic circuit for generating transmitted parity bits

iii) [10]

Received Bit at Receiver			Parity Check	Recovered or Corrected Data
D	P	Q	C	R
0	0	0*	1	0
0	0	1	0	0
0*	1	0	1	1
0	1*	1	1	0
1	0*	0	1	1
*1	0	1	1	0
1	1	0	0	1
1	1	1*	1	1
* Corrupted data				

v) [8]

$$C = (D + P + Q')(D' + P' + Q)$$
$$R = D'PQ' + DP'Q' + DPQ' + DPQ$$

Optional:

D \ PQ	00	01	11	10
0	m_0 0	m_1 0	m_3 0	m_2 1
1	m_4 1	m_5 0	m_7 1	m_6 1

$$R = DQ' + DP + PQ'$$

D \ PQ	00	01	11	10
0	m_0 1	m_1 0	m_3 1	m_2 1
1	m_4 1	m_5 1	m_7 1	m_6 0

$$C' = D'P'Q + DPQ'$$
$$C = (D + P + Q')(D' + P' + Q)$$

This document is for the internal use only for students of ITI1100X Summer 2016 UOttawa. Further distribution or reproduction is strictly prohibited.