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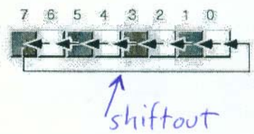
EECS 281: **Test 4 (4 pages)** **Due: Tuesday, November 23, 2004**

Name: ______________ Email: ______________ Grade: _______ (100 points max)

1. (15 points) Write a function which rotates an 8-bit character left 1-bit. For example, rol1(0x81) returns 0x03; rol1(0xc0) returns 0x81.



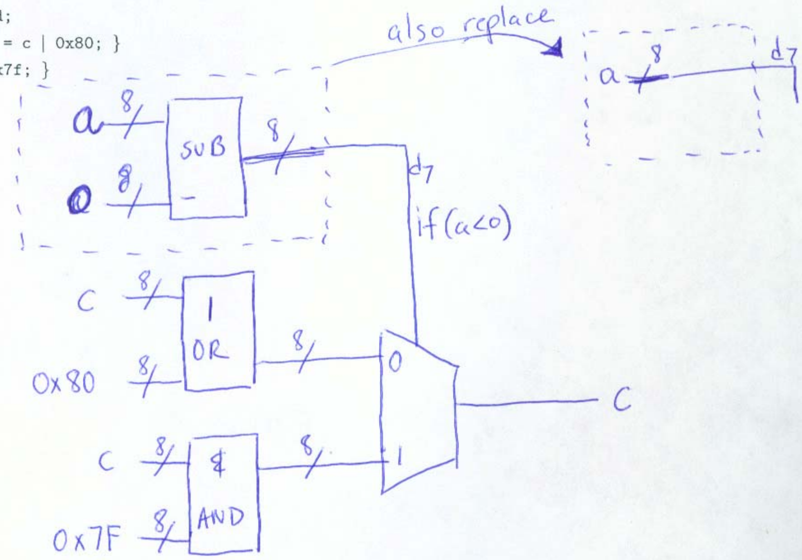

```
char rol1(char a) {
    int shiftout;
    shiftout = (a & 0x80)? 1: 0;
    a = ((a<<1) & 0xfe) | shiftout;    /* also can use 0xff */
    return shiftout;
}
```

Best solution

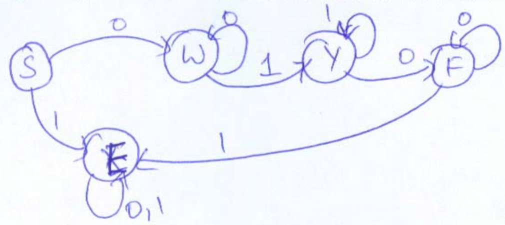
```
char rol1(char a) {
    return ((a<<1) | ((a & 0x80)? 1:0)) & 0xff;
}
```

2. (15 points) Draw the Dataflow diagram for the following code. The char size is 8-bits.

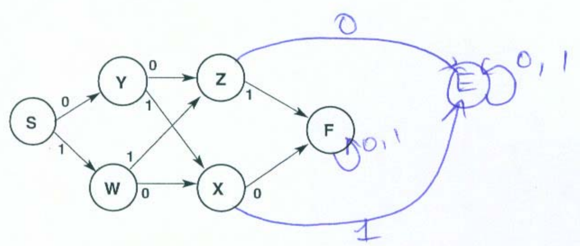
```
char a, b, c, d;
if ( a<0 ) { c = c | 0x80; }
else { c=c & 0x7f; }
```



3. (10 points) Draw the state transition diagram for a 1-bit input for the regular expression "0+1+0+". Use the following state symbols: S for start, F for final, E for Error and W, X, Y, Z, for all others.



4. (15 points) Given the state transition diagram for a 1-bit input (a) draw the error state, E, for the missing inputs and (b) give the transition table.



Q	0	1
S	Y	W
W	X	Z
Y	Z	X
Z	E	F
X	F	E
F	F	F
E	E	E

5. (15 points) Given the transition table, give the state encodings using S=11, W=10, E=00 and F=01.

Q	0	1
W	S	F
F	W	S
S	F	W

Current			Q_{next}	
q_1	q_0	i	q_1	q_0
1	0	0	1	1
1	0	1	0	1
0	1	0	1	0
0	1	1	1	1
1	1	0	0	1
1	1	1	1	0
0	0	0	X	X
0	0	1	X	X

Inputs

Q	0	1
W=10	S=11	F=01
F=01	W=10	S=11
S=11	F=01	W=10

6. (15 points) (a) Give the three excitation optimal k-map of the transition encoded table and clearly show circles. Treat each k-map independently (i.e. do not do multi-output k-map optimisation). (b) Give the minimal SOP expression for each k-map. Let $q_1 = a$, $q_0 = b$ and $i = c$.

q_1	q_0	i	q_1	q_0
0	1	0	1	0
0	1	1	1	0
1	0	0	0	1
1	0	1	0	1

q_1	$\overline{b}\overline{c}$	$\overline{b}c$	bc	$b\overline{c}$
$\overline{a}$	X	X	1	1
a			X	X

q_0	$\overline{b}\overline{c}$	$\overline{b}c$	bc	$b\overline{c}$
$\overline{a}$	X	X		
a	1	1	X	X

other solution

Solution1 Solution2 ; Both are ok

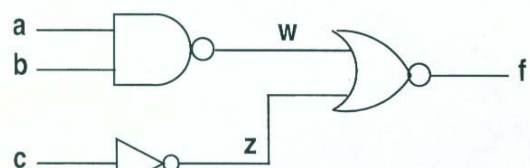
The Rest of the truth table would be

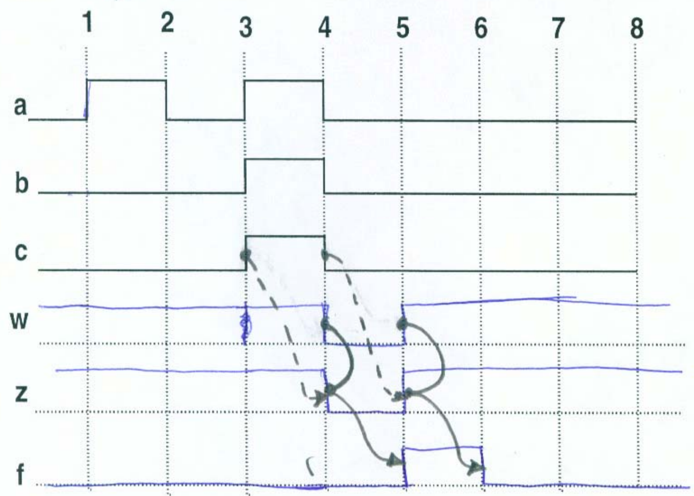
q_1	q_0	i	q_1	q_0
0	0	0	X	X
0	0	1	X	X
1	1	0	X	X
1	1	1	X	X

MSOP of q_1 is $\overline{a}$ or b

MSOP of q_0 is a or $\overline{b}$

7. (15 points) Given the following gate logic diagram draw the timing diagram including the triggering lines. Each logic gate has 1 nanosecond delay.

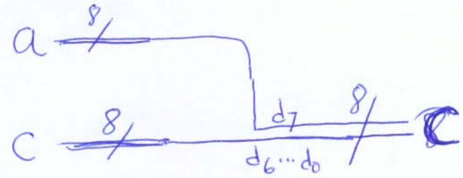




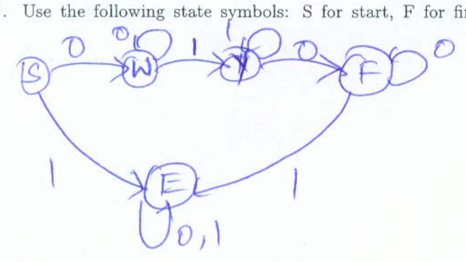
x1. (extra credit, 10 points) Write a multi-precision function which rotates left by 1 bit and returns the rotated out bit: `char rol1_char(char *f, char *a, ~~char *an~~ int an) {`

```
int i, shiftout, shiftin;
shiftin = (a[0] & 0x80)? 1:0;
for (i=an-1; i>=0; i--) {
    shiftout = (a[i] & 0x80)? 1: 0;
    f[i] = ((a[i]<<1) & 0xfe) | shiftin;
    shiftin = shiftout;
}
return shiftout; }
```

x2. (extra credit, 10 points) Draw the Dataflow diagram of problem 2 using **only wires** and no logic gates, arithmetic logic, or transistors.



x3. (extra credit, 10 points) Draw the state transition diagram for a 1-bit input for the regular expression "00*11*00*". Use the following state symbols: S for start, F for final, E for Error and W, X, Y, Z, for all others.



Coincidentally
$00^*11^*00^*$
$= 0^+1^+0^+$

x4. (extra credit, 10 points) Given the three input bit string of problem 4. (a) Show the truth table if the final state, F, is true and the error state, E, is false. (b) What is the minimal boolean expression for this function?

a	b	c	Output	Output
0	0	0	E	E
0	0	1	F	F
0	1	0	F	F
0	1	1	E	E
1	0	0	F	F
1	0	1	F	E
1	1	0	E	E
1	1	1	F	F

Output expression
= ~~a+b+c~~;
= a XOR b XOR c
= $a \oplus b \oplus c$