COE/EE 243 **From Fall 98**

Sample Final Exam
Solutions

Show your work. Do **NOT** use a calculator!

1. (9 pts) Complete the following table of equivalent values.

Binary	Octal	Decimal	Hexadecimal
1011.0011	13.14	11.1875	B.3
11101.11111101	35.77	29.99	1D.FD
11011.010011	33.23	$27\ \frac{19}{64}$	1B.4C

2. (12 pts) Calculate the following
   a) $(11001)_2$ plus $(101)_2$ $= 11110$
   b) $(11010)_2$ minus $(10101)_2$ using 1's complement representation $= 000101$
   c) $(1101)_2$ times $(1001)_2$ $= 1110101$
   d) $(101101)_2$ divided by $(110)_2$ $= 111.1$

3. (9 pts) Complete the following table of equivalent values. Use binary numbers with a sign bit and 5 bits for the value

Decimal	Signed Magnitude	Two's Complement	One's Complement
-11	101011	110101	110100
-2	100010	111110	111101
-1	100001	111111	111110

4. (8 pts) Give the Characteristic equations and the Excitation tables for the *SR* and *JK* flip-flops.

SR flip-flop

$$Q+ = S + R'Q$$

S	R	Q	Q+
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	-
1	1	1	-

JK flip-flop

$$Q+ = JQ' + K'Q$$

J	K	Q	Q+
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

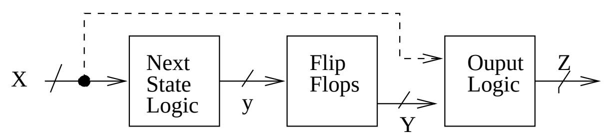
5. (10 pts) (a) Explain the difference between a **Moore** machine and a **Mealy** machine.

   Sol The outputs in a Moore machine depend only on the present state. The outputs in a Mealy machine depend on both the present state and the present input.

   (b) What is the same about both kinds of state machines?

   Sol Both have present state dependent on past inputs.

   (c) Draw a block diagram indicating the structure of a general state machine. Indicate on the diagram where one can find the **present state** and **next state**.



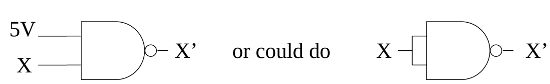
6. (5 pts) Give a truth table and a standard sum of products expression that describes $F = A \oplus B \oplus C$

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

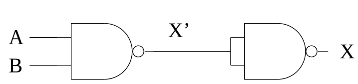
$$F = AB'C' + A'B'C + A'BC' + ABC$$

7. (8 pts) Indicate how a Nand gate can be used to implement:

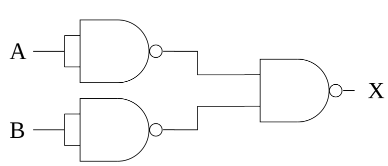
   (a) An Inverter:



   (b) An And Gate:



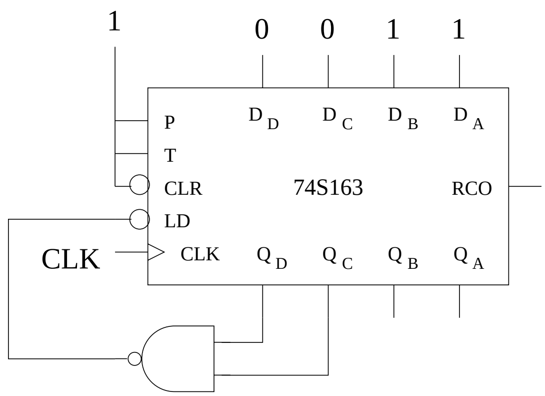
   X = A + B
   = (A’B’)’



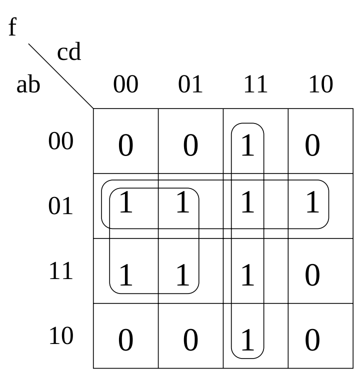
   (c) An Or Gate:

   (d) Because a Nand gate can be used to implement all three basic Boolean functions, how would we describe it? **Functionally Complete**

8. (8 pts) Using the 74ALS163 counter shown below and logic gates design a counter that counts in the sequence 3,4, 5, 6, 7, 8, 9, 10, 11, 12, 3, ... Connect all unused inputs. The counter may cycle through several unwanted states before settling into the final count sequence. Q_d is the MSB of the counter output.



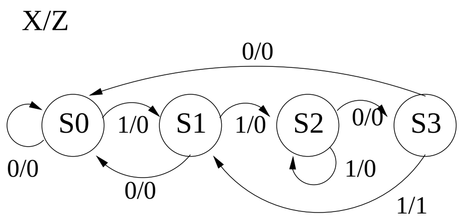
9. (6 pts) Find a minimum sum of products expresssion for $F = abc' + bc'd' + cd + a'b$



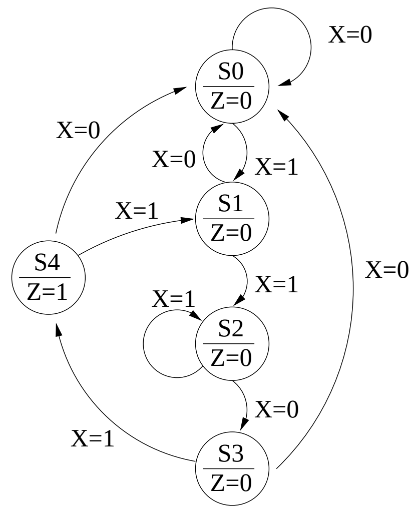
F = a’b + cd + bc’

10. (10 pts) Create a state diagram for a sequence detector that outputs a 1 when it detects the final bit in the serial data stream 1101.

Mealy Machine

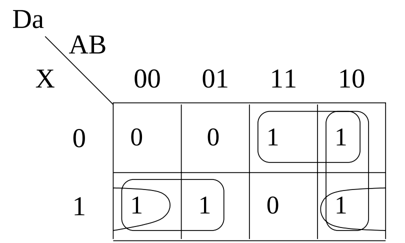


Moore Machine

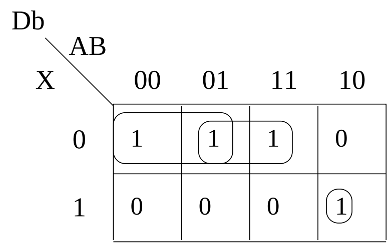


11. (10 pts) Determine the D flip-flop excitation equations for the system represented with in the state-transition table below. Assign states: $S0 = 00$, $S1 = 01$, $S2 = 10$ and $S3 = 11$.

Present **AB**	Present S	Next State X=0	Next State X=1	Output Z
00	S0	S1	S2	0
01	S1	S1	S2	1
10	S2	S2	S3	1
11	S3	S3	S0	0

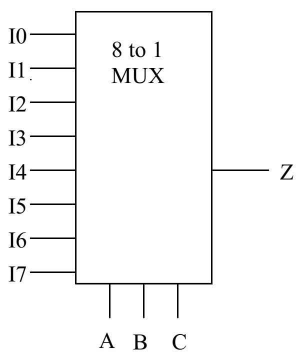


Da = X'A + XA' + {AB' / XB'}



Db = XAB' + X'A' + X'B

12. (5 pts) Give the output expression for the 8-to-1 MUX shown below.



$$Z = A'B'C'I0 + A'B'CI1 + A'BC'I2 + A'BCI3 + AB'C'I4 + AB'CI5 + ABC'I6 + ABCI7$$