Question 1

Draw a table of 4-bit binary values like the following example table with unsigned and signed value.

bits	unsigned	signed
0 0 0	0	0
0 0 1	1	1
0 1 0	2	2
0 1 1	3	3
1 0 0	4	-4
1 0 1	5	-3
1 1 0	6	-2
1 1 1	7	-1

Then use signed binary to calculate: 2 + 5, 2 - 5, -5 - 2

answer:

bits	unsigned	signed
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	-8
1001	9	-7
1010	10	-6
1011	11	-5
1100	12	-4
1101	13	-3
1110	14	-2
1111	15	-1

2 -> 0010
5 -> 0101
-5 -> 1011
-2 -> 1110

2 + 5 = 7	2 - 5 = -3	-2 + (-5) = -7
0010 0101 — —- 0111	0010 1011 — —- 1101	1110 1011 -- — —- 1 1001

Question 2

For C programming language, give the integer range for these data types:

Type
char
unsigned char
signed char
int
unsigned int
short
unsigned short
long
unsigned long

answer:

| Type	Storage size	Value range
char	1 byte	-128 to 127 or 0 to 255
unsigned char	1 byte	0 to 255
signed char	1 byte	-128 to 127
int	2 or 4 bytes	-32,768 to 32,767 or -2,147,483,648 to 2,147,483,647
unsigned int	2 or 4 bytes	0 to 65,535 or 0 to 4,294,967,295
short	2 bytes	-32,768 to 32,767
unsigned short	2 bytes	0 to 65,535
long	8 bytes or (4bytes for 32 bit OS)	-9223372036854775808 to 9223372036854775807
unsigned long	8 bytes	0 to 18446744073709551615

Question 3

Following the lecture ROM example, draw a ROM with 4bit address and 8bit width.
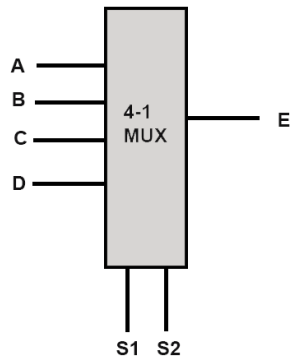
answer:

following is a 3bit address version
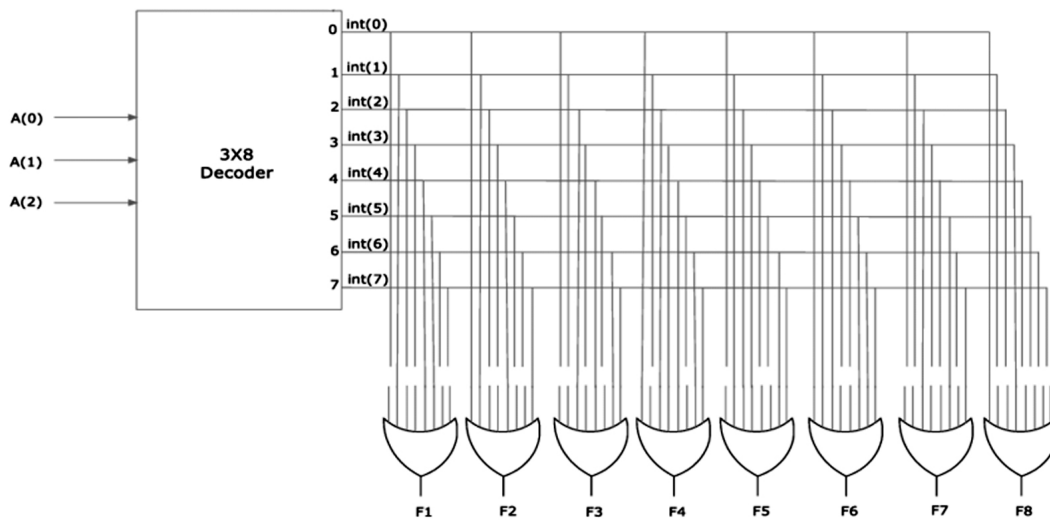
Question 4

Following is a 4-1 multiplexor with 4 input and 2 selector

a. create a truth table for this 4-2 multiplexor
b. write formal form of logic formula for this truth table
c. implement the 4-1 multiplexor from this formula (draw a circuit diagram)

answer:

a. truth table

s1	s2	E
0	0	A
0	1	B
1	0	C
1	1	D

b. formula

$$(A \cdot \overline{S_1} \cdot \overline{S_2}) + (B \cdot \overline{S_1} \cdot S_2) + (C \cdot S_1 \cdot \overline{S_2}) + (D \cdot S_1 \cdot S_2)$$

c. implementation