1. (10 Points) Convert $(4132)_{10}$ to bases, $r = 2$, $r = 5$, and $r = 16$.

   Solution:
   $$(4132)_{10} = (1000000100100)_2 = (113012)_5 = (1024)_{16}$$

2. (10 Points) Convert $(41.3)_{10}$ to bases, $r = 2$, $r = 3$, and $r = 16$.

   Solution:
   $$(41.3)_{10} = (101001.0\overline{1001})_2 = (1112.\overline{0220})_3 = (29.4\overline{C})_{16}$$

3. (5 Points) Convert the binary number 10010011.11011 to octal and hexadecimal.

   Solution:
   $$(10010011.11011)_2 = (223.66)_8 = (93.D8)_{16}$$

4. (5 Points) Convert the hexadecimal number AB2C.F3 to binary and octal.

   Solution:
   $$(C23A.4E)_{16} = (1010101100101100.11110011)_2 = (125454.746)_8$$

5. (10 Points) Take the two binary numbers $a = 110110010$ and $b = 100110111$ and calculate $a + b$, $a - b$, and $a \cdot b$, using binary arithmetic.

   Solution:
   $$\begin{aligned} a + b &= 1011101001 \\ a - b &= 1111011 \\ a \cdot b &= 1000001111001111110 \end{aligned}$$

6. (10 Points) Take the two hexadecimal numbers $a = 43F2$ and $b = AD4$ and calculate $a + b$, and $a - b$, using hexadecimal arithmetic.

   Solution:
   $$\begin{aligned} a + b &= 4EC6 \\ a - b &= 391E \end{aligned}$$

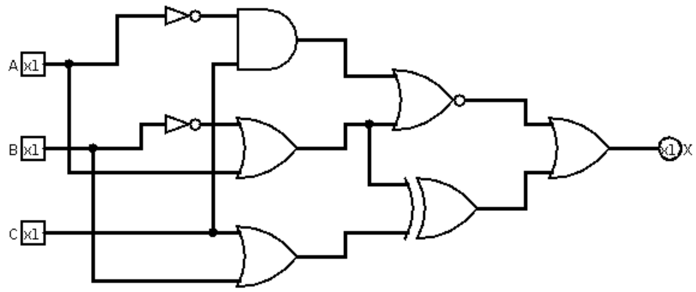
7. (5 Points) Find the 1's and 2's complement of $(99)_{10}$, using byte storage with one sign bit.

   Solution: $(99)_{10} = (1100011)_2$, so the 1's complement, using byte storage and a single sign bit, is
   $$(-99)_{10} = 10011100$$
   and the 2's complement is
   $$(-99)_{10} = 10011101$$

8. (5 Points) Convert $(50)_{10}$ to binary and then using the 2's complement of $(99)_{10}$ and addition, calculate $50 - 99$ in binary form.

   Solution:
   $$\begin{aligned} (50)_{10} &= 00110010 \\ (50 - 99)_{10} &= 11001111 = (-49)_{10} \end{aligned}$$

9. (50 Points) Do the following for the circuit below.



(a) Construct the truth table for the circuit.
Solution:

A	**B**	**C**	**X**
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0

(b) Write the circuit's logical function in canonical SOP form.
Solution: $X = A'B'C' + A'BC' + A'BC + AB'C'$

(c) Write the circuit's logical function in canonical POS form.
Solution: $X = (A + B + C')(A' + B + C')(A' + B' + C)(A' + B' + C')$

(d) Write the circuit in minterm form.
Solution: $X = \Sigma m(0, 2, 3, 4)$

(e) Write the circuit in maxterm form.
Solution: $X = \Pi M(1, 5, 6, 7)$

(f) Write the K-Map for the circuit, show the groupings you would use, and then construct the minimized logical circuit function in both SOP form and POS form.
Solution:

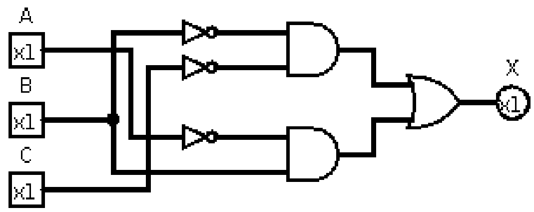
	A B			
C	00	01	11	10
0	1	1		1
1		1		

Use two groups, column 01, and the 000/100 cells. Equation (1) is SOP and equation (2) is POS.

$$X = A'B + B'C' \quad (1)$$
$$X = (A' + B')(B + C') \quad (2)$$

(g) Using the K-Map work, write the circuit diagram of the minimized circuit.

Solution:



(h) Do the Quine-McCluskey procedure on the original circuit, show all steps in the derivation. Construct the minimized logical circuit function in SOP form.

Solution:

000	0–0	(0,2)	PI_1
010	–00	(0,4)	PI_2
100	01–	(2,3)	PI_3
011			

	0	2	3	4
PI_1	×	×		
PI_2	×			⊗
PI_3		×	⊗	

So PI_2 and PI_3 are essential and we get all of the minterms with those two, giving $X = A'B + B'C'$.