4.(a) $36_{(8)} = 3 \times 8^1 + 6 \times 8^0 = 24 + 6 = 30_{(10)}$

```
4 | 30
4 |  7   2
4 |  1   3
     0   1
```

$132_{(4)}$

```
6 | 30
6 |  5   0
     0   5
```

$50_{(6)}$

5.

```
       1111101
        110110
--------------
       0000000
      1111101
     1111101
    0000000
   1111101
  1111101
--------------
 1101001011110
```

6.

$$
\begin{array}{r}
10011.000 \\
111 \overline{)\,10000101} \\
\underline{1110000} \\
0010101 \\
\underline{1110} \\
0111 \\
\underline{111} \\
0
\end{array}
$$

7. (b) $xy' + y = x + y$

(b under x, c under y', a under y)

$= (y + x)\cdot(y + y')$

$= (y + x)\cdot 1 = x + y$

$(a+b)(a+c) = a + bc \iff$

$= aa + ac + ab + bc$

$= a(1 + c + b) + bc$

$= a + bc$

CE241 Midterm Exam (90 min)

Close-book, close-notes. Calculators are prohibited during the exam. Feel free to ask me questions through emails during the exam.

1. Convert the following binary numbers to decimal numbers (unsigned): (10 points)
(a) 1011110
(b) 1101.11

2. Convert the following decimal numbers to binary numbers (unsigned): (10 points)
(a) 32
(b) 48.625

3. Convert the decimal number to hexadecimal and then to binary (unsigned): (10 points)
(a) 48.15

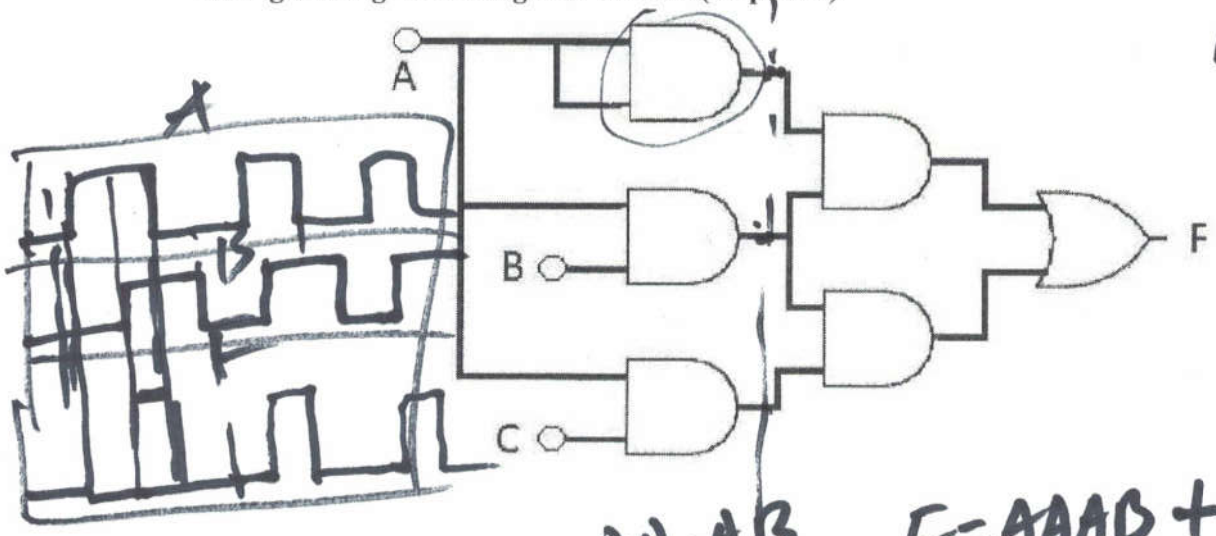
4. Convert the octal number to a 4-based and a 6-based number respectively. (use its decimal form as the intermediate number for the conversion). (10 points)
(a) $36_{(8)}$

5. Add, subtract, and multiply in binary (unsigned): (10 points)
1111101 and 110110

6. Divide in binary (unsigned) (keep 3 digits after the point): (10 points)
10000101/111

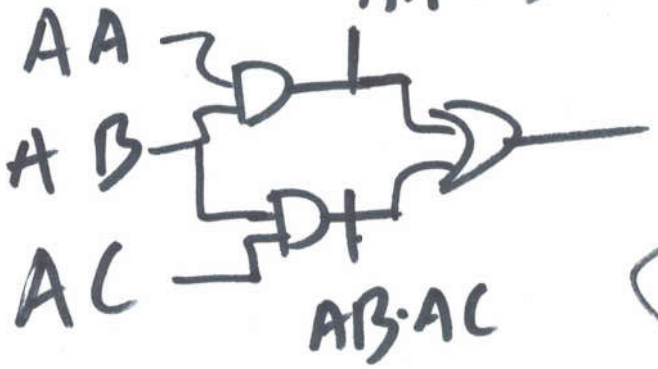
7. Prove the following theorems algebraically: (show the process for credit) (20 points)
(a) $(X+Y)(X+Z)= X+YZ$
(b) $XY'+Y=X+Y$
(c) $XY+YZ+X'Z=XY+X'Z$
(d) $X'Y + XY' = (X'Y' + XY)'$

8. (a) Simplify the following logic circuit. (b) Build the simplified circuit in LTSpice, verify the logic using DC voltages or Pulses: (20 points)



A·A = A ?

AA·AB



F = AAAB + ABAC
= AB + ABC
= AB(1+C)
= AB

(4)

(d) $A \oplus B = \overline{A \odot B}$

$A\bar{B} + \bar{A}B \neq \bar{A}\bar{B} + AB$

$\overline{\bar{A}\bar{B} + AB} = \overline{\bar{A}\bar{B}} \cdot \overline{AB} = (\bar{\bar{A}} + \bar{\bar{B}})(\bar{A} + \bar{B})$

$= (A+B) \cdot (\bar{A} + \bar{B}) = A\bar{A} + A\bar{B} + \bar{A}B + B\bar{B}$

$= A\bar{B} + \bar{A}B$

8.

(3)