1) (7 Points)
a) Convert the decimal number 1234 to binary.

b) Convert the decimal number 9083 to binary-coded decimal (BCD).

c) Convert the binary number 1001.11 to its decimal equivalent

d) A device detects three particles A, B, and C. You are designing a readout that will light up when A and B are detected simultaneously provided that no C particle is detected at the same time. Otherwise, the readout should not light up. Write down a simple logic circuit (using ordinary two input gate symbols) that performs this function.

e) Design a circuit to implement the Boolean expression \((\overline{A} + \overline{B})C\) using only NAND gates.

2) (6 Points) A D-type (7474) positive edge-triggered flip-flop is fed with a pulse train as shown in the figure 1. Prepare a timing diagram on the additional sheet provided, showing the input pulse train (at least four full cycles) along with \(Q\), \(\overline{Q}\), X and Y.

![Figure 1](image-url)
3) **(7 Points)** Write a C-function with two arguments $a$ and $b$ that returns the value $s$ as shown in equation 1:

$$ s = \sum_{i=a}^{b} \frac{i}{b-a} $$

(Equation 1)

While arguments $a$ and $b$ are of integer type, you should use appropriate data types for the other variables to get a reasonable accuracy of the result. You may name the function anything except "main." Write the entire function with function declaration, header, body and return statement. You may write it using as many or as few additional local variables as you consider necessary.

Note: You do NOT need to check for the special cases $b - a = 0$ or that $b > a$.

You will be graded on a) program logic and b) number of syntax mistakes.

4) **(5 Points)** In the program shown below, determine the values of $i_1$, $i_2$, $i_3$, $i_4$ and $i_5$ when they program executes the `printf` statement. You may express your answer in decimal or hexadecimal notation.

```c
#include <ansi_c.h>
main( )
{
    short u = 129, v = 0xFD3;
    short i1, i2 = 0, i3, i4, i5;

    i1 = u / 10.0;
    i2 += u;
    i3 = (u>>2)&&(v<<16);
    i4 = (u & v) | v; // | is the OR-operator
    i5 = u ^ v; // ^ is the XOR-operator
    printf("i1: %d\ti2: %d\ti3: %d\ti4: %d\ti5: %d\n", i1, i2, i3, i4, i5);
}
```
2) (6 Points) A D-type (7474) positive edge-triggered flip-flop is fed with a pulse train as shown in the figure 1. Prepare a timing diagram on the additional sheet provided, showing the input pulse train (at least four full cycles) along with Q, Q, X and Y.
1a) 1234 => 0x4D2 => 0100 1101 0010
1b) 9083 => 1001 0000 1000 0011 BCD
1c) 1001.11 => 1*2^3 + 0*2^2 + 0*2^1 + 1*2^0 + 1*2^-1 + 1*2^-2 = 8 + 1 + 1/2 + 1/4 = 9.75
1d)

2) float Mid1(short a, short b); //function declaration
   float Mid1(short a, short b) //function header
   {
      short i;
      long sum = 0;
      for(i = a; i < b; i++)
         sum+=i;
      return (float)sum/(b - a);
   }

3) i1: 12  i2: 129  i3: 0  i4: 4051 i5: 3922