Problem 1.

① logic (bitwise operations, etc)

② data handling & memory (load, store)

③ flow control (branch, call)

Problem 2

SUB X6, X31, X1

Problem 3

ADD X10, X0, X1

ADD X10, X10, X2

ADD X10, X10, X3

LSL X10, X10, 2

Problem 4. (20 points) Comment each line of code to explain what it does.

Part a)

```
struct coord { int x, y; }; declare struct with two integer field
struct coord start;   declare a struct variable start
start.x = 1;   assign field x to 1
struct coord *myLoc;   create a pointer myLoc points to struct
myLoc = &start;   dereference variable start and store address in myLoc
myLoc->y = 2;   set y field in start as value 2
```

Part b)

```
int scores[8];   creat an array with 5 elements
scores[1]=5;   set second elements as 5
int *index = scores;   declare a pointer points to first element in scores
index++;   increas index by 1
(*index)++;   increase first element in score by 1
index = &(scores[3]);   index now points to the 4th element in scores
*index = 9;   set 4th element in scores as value 9
```

Problem 5. (25 points) Number system conversions and binary arithmetic

97_{10} = 1100001 $_2$ = 141 $_8$ = 61 $_{16}$

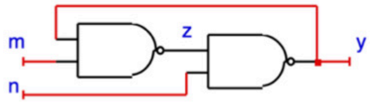
$1011\ 0101_2$ = 181 $_{10}$ = 265 $_8$ = B5 $_{16}$

-58_{10} = 11000110 (eight-bit, two's complement)

If you add 97_{10}, and -58_{10} using 8-bit two's complement arithmetic, do you get an overflow? No

58_9 = 53 $_{10}$ = 65 $_8$ = 35 $_{16}$

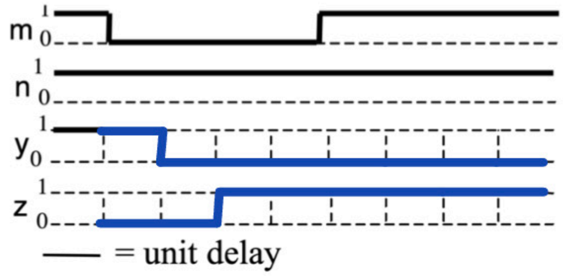
Problem 6. (15 points) A NAND latch is constructed as shown. Each gate has a unit delay.



Given input waveforms m and n, determine the waveforms for y and z.

$Z = \overline{Y \cdot m}$

$y = \overline{Z \cdot n}$



Problem 7.

C \ AB	00	01	11	10
0	0	1	0	0
1	0	1	1	1

Problem 7. (20 points) Recap of combinational and sequential logic systems

Consider the Boolean function: $f(x, y, z) = (x + y)(\bar{x} + z)(y + z)$

a. (5 points) Draw the Karnaugh map for this function.

b. (5 points) Use Boolean algebra to find the equivalent canonical sum-of-products expression:

$f_{SOP}(x, y, z) =$ $\bar{X}Y\bar{Z} + \bar{X}YZ + A\bar{B}C + ABC$

c. (5 points) Use Boolean algebra to find the equivalent canonical product of sums expression:

$f_{POS}(x, y, z) =$ $(A+B+C)(A+B+\bar{C})(\bar{A}+\bar{B}+C)(\bar{A}+B+C)$

d. (5 points) Simplify the above function, into a minimal sum of products form:

$f_{\min}(x, y, z) =$ $(XZ + Y\bar{X})$