THE UNIVERSITY OF BRITISH COLUMBIA
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
APSC 380 : Introduction to Microcomputers
1997/98 Winter Session Term 2

MID-TERM EXAMINATION
9:30 am – 10:20 am
February 25, 1997

This exam has four (4) questions. The marks for each question are as indicated. There are a total of 28 marks. Answer all questions. Write your answers in the exam book provided. Show your work. You may answer the questions in any order. Books, notes and calculators are allowed. You may keep this exam paper.

Question 1 (5 marks)

What is printed by the following C program? Show your work.

```c
#include <stdio.h>
#define N 5

main()
{
   int i, c ;
   char x[N] = { 0, 4, 3, 2, 1 } ; /* values of x[0], x[1], ... */
   for ( i=N-1 ; x[i] ; i-- ) {
      c = x[i] & 0x02 ;
      printf ( "%d\n", c ) ;
   }
}
```

*Hint: Start by figuring out the values taken on by* i.

Question 2 (8 marks)

Write a C function called `blanks()` that takes one null-delimited string argument called `s`, and returns an integer. This function should return a count of the number of spaces (' ') in the string. Write only the function `blanks()`, not a complete program.

For example, `blanks("A nice function")` would return 2.

Question 3 (11 marks)

This question asks you to design a controller for a device that raises a flag up a flagpole in the morning and lowers it at night:
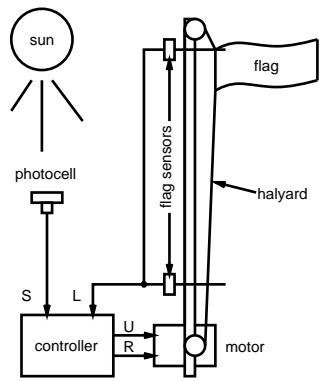
The halyard used to raise and lower the flag is driven by a motor. Two signals control the operation of this motor. The first, U controls the motor direction: it should be set high to move the flag up and low to move the flag down. The second signal, R, turns the motor on and off: it should be set high to run the motor and low to leave it off.

Your controller uses a signal from a photocell, S, whose output is high during the day. Your controller also has a signal L that goes high to indicates that the flag has reached either the top or bottom limit of the flagpole (this sensor cannot determine which limit has been reached).

Design a state machine controller for the motor controller. List the inputs and outputs. Choose a sufficient number of states and give a name to each state. Write a table giving the output conditions for each state. Draw a state transition diagram showing the states and the logical conditions that cause transitions between them. Write out a tabular description of the state machine with the following columns: starting state, input, next state.

Use "X" to indicate that an *input* has no effect. You may assume the flag will reach its limit before the next sunrise or sunset.

Hint: You may need more states than there are combinations of outputs.

Question 4 (4 marks)

A 2-to-4 decoder is a combinational circuit with two inputs and four outputs. At all times only one of the four outputs is high. The two inputs select which of the four outputs is to be set high as shown in the following truth table:

inputs		outputs			
A	B	Y0	Y1	Y2	Y3
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1

Derive the logic equations for each of the outputs. Draw a schematic diagram for the decoder using AND, OR and NOT gates.