THE UNIVERSITY OF BRITISH COLUMBIA

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

APSC 380 : Introduction to Microcomputers

1997/98 Winter Session Term 1

MID-TERM EXAMINATION

8:30 am – 9:20 am

October 24, 1997

This exam has three (3) questions. The marks for each question are as indicated. There are a total of 30 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 (10 marks)

What is printed by the following C program?

```c
#include <stdio.h>

main()
{
    int i, x ;
    i = 4 ;
    while ( i <= 7 ) {
        x = i & 0x2 ;
        printf ( "%d\n", x ) ;
        i = i + 1 ;
    }
}
```

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

Question 2 (10 marks)

Write a C function called powers3() that takes one integer argument called max, and returns an integer. This function must print each power of 3 $(1, 3, 9, 27, \ldots)$ that is less than or equal to max. The function should return the last value printed. Each value must be printed on a separate line. You may assume that max $\geq$ 1.

Write only the function powers3() not a complete program.

For example, power3(10) would return 9 and print the three lines:

Question 3 (10 marks)

Design the state machine for a motor controller with a special safety feature as described below. The controller has two inputs labelled power and start and one output labelled run. The run output controls the motor. The two inputs are push-button switches. If the motor is running, then pushing the power button when the start button is *not* pressed turns the motor off. If the motor is off then *both* the power and start buttons must be pushed to turn on the motor. Other input conditions do not have any effect on whether the motor is on or off.
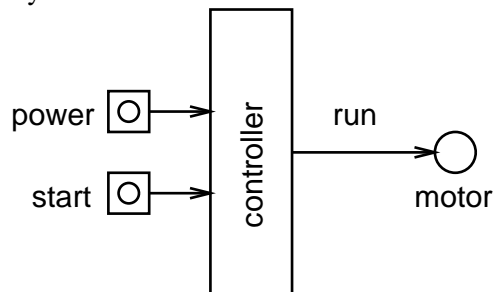
Design a state machine controller for the motor controller. List the inputs and outputs. Choose a sufficient number of states and give a name to each state. Write a table giving the output conditions for each state. Draw a state transition diagram showing the states and the logical conditions that cause transitions between them. Write out a tabular description of the state machine with the following columns: starting state, input, next state.