Assignment 2

due February 8 1999 (9:30 AM)

Question 1

(a)

Design a controller for a coin-operated widget-vending machine. The machine's coin detector can detect quarters, $1 coins and $2 coins.

The coin detector has two output lines encoded as follows:

00	quarter
01	$1 coin
10	$2 coin

The vending machine has an electrically-driven widget-release mechanism. The release mechanism delivers one widget each time its control line goes from zero to one.

A widget costs $1.25. The machine does not give change or have a coin return.

You may assume there is one rising edge of the clock signal each time a coin is inserted and also when a widget is released. Show where this clock signal would be connected in the circuit.

Hint: your controller needs to keep track of the amount collected.

(b)

Design a digital logic controller for a pedestrian-controlled street crossing.

The controller controls three traffic lights labelled `r` (red), `y` (yellow) and `g` (green) and two pedestrian crossing lights labelled `w` (walk) and `n` (don't cross).

The controller senses a pushbutton that pedestrians push when they want to cross the street. The controller also senses the outputs of two timers: `s` (which goes active 5 seconds after the `y` is turned on) and `l` which goes active 30 seconds after the `r` light is turned on.

The controller's state changes are controlled by a 10 Hz clock.

The controller normally leaves the green traffic light on. When a pedestrian wants to cross the street the controller turns on the yellow light for 5 seconds then turns on the `r` and `w` lights for 30 seconds and then return to it's normal state.

For each of these two designs provide the following:

1. a list of the inputs and outputs for this controller.
2. a set of suitable set of states for the controller and their binary encodings
3. a tabular description of the state transition diagram showing the state name, the input conditions, and the next state. You may use the value `x` to indicate "don't care."
4. a state transition diagram for the controller showing the possible states and the transition conditions. Transition conditions resulting in no change of state need not be shown.
5. a table showing the symbolic and encoded outputs for each state.
6. the sum-of-products boolean expressions for each output signal and for each signal necessary to determine the next state. You need not simplify your expressions.
7. a schematic diagram for the controller that uses only D flip-flops, NOT inverters and multiple-input AND and OR gates. Use standard symbols for the gates. Show where the clock would be connected.