CoE/EE 460
Spring 2001 : Lockwood

Homework #7: Due Wednesday, April 25, 2001
at 5:00pm, in EE homework box

Name:	

1. Consider the implementation of a Finite State Machine (FSM) which monitors the transmission of data bits on a high-speed, serial, optical link. In order to properly bias the laser, signals are needed to indicate when 80% or more of the last 5 bits have been encoded as a "1" or when 20% or less of the last 5 bits have been encoded as a "1".

   Using an informal method (as was done in Lecture 16), Design a Moore FSM that generates:

   - An output signal called "PowerHigh" that only goes high ("1") whenever it detects that 4 or more of the last 5 bits of the input, X, have been encoded as "1"
   - An output signal called "PowerLow" that only goes high ("1") whenever it detects that the 1 or fewer of the last 5 bits of the input, X, have been encoded as "1".

   (a) How many Flip/Flops will you need to implement this FSM

   (b) Write the equations for each of the next-state transition functions, $\delta_i(S, X)$.

   (c) Write the minimal SOP equations for each Output function, $\lambda_L(S)$ and $\lambda_H(S)$.

2. Consider the Morse-Code decoder discussed in Lecture 17.

   (a) Complete the State Transition Diagram (STG) so that all letters (A-Z) can be decoded by a FSM. Show your work.

   (b) How many States are required in your implementation? Explain.

   (c) What is the least number of Flip/Flops required to implement this machine machine ? Explain.

   (d) How many Flip/Flops are required to implement the state machine if one-hot encoding is used? Explain.

3. Implement a state machine that can encode the letters {A, B, C, D, and E} in Morse code.

   - Assume that the input, $X = \{X_A, X_B, X_C, X_D, X_E\}$ will never have more than one bit high on any given clock cycle.
   - Force the output, Z, to be "1" for a single clock cycle in order to transmit a dot.
   - Force the output, Z, to be "0" for three clock cycles in order to transmit a dash.
   - Force Z to be "0" for a single clock cycle between the transmission of dots or dashes.
   - For Z to be "0" for three cycles between the transmission of each input symbol.

   (a) Show the State Transition Graph of the circuit which implements your encoder.

   (b) Show the state encoding for your machine, S, and explain why you used that encoding.

   (c) Compute the Next-state functions, $\delta(S, X)$. Show your work.

   (d) Compute the Output function, $Z = \lambda(S, X)$.

4. Consider the following state machine:

S_i	S_{i+1}/Z_i $\|x=0$	S_{i+1}/Z_i $\|x=1$
A	E/0	C/0
B	C/0	A/0
C	B/0	G/0
D	G/0	A/0
E	F/1	B/0
F	E/0	D/0
G	D/0	G/0

(a) Using the Partition-Refinement algorithm, Identify P_0. Show your work.

(b) Using the Partition-Refinement algorithm, Identify P_1 Show your work.

(c) Using the Partition-Refinement algorithm, Identify P_2 Show your work.

(d) Using the Partition-Refinement algorithm, Identify P_3 Show your work.