ECE/CS 5960/6961 – Design Homework 1

In this homework you will perform the design of some simple systems using flow tables as
the specification. A logic design will be synthesized from the flow table specification. The design
work that you perform here in this homework is the foundation of the hard part of asynchronous
design...that of building custom sequential asynchronous finite state machines. In later assign-
ments we will use other formal design specifications and synthesis algorithms.

You will create three designs for this homework.

1. Unger Problem 1.2, page 27.
2. Unger Problem 1.3, page 27.
3. The 4-cycle toggle.

The 4-cycle toggle element has the structural channel connectivity as shown in Fig. 1. It has
one input channel and two downstream output channels. Each channel performs a four-cycle return
to zero protocol. All activity is initiated by the left channel. Upon receiving a rising left request lr
output, channel zero will respond by raising its right request rr0. The system will wait for the rising
right acknowledgment on that channel ra0, at which point the left acknowledgment signal la will
raise. The same sequence will be followed for the falling transitions. For the subsequent assertion
of lr, the handshake will be steered to the channel 1 on the right side. All even transactions on the
left channel (0, 2, 4, ...) will be sent to right channel zero, and all odd transactions (1, 3, 5, ...) will
be sent to right channel 1.

Figure 1: Structural description of the 4-cycle toggle controller

For each of these designs, include:
1. A primitive flow table.
2. A pair chart showing compatibility between primitive states.
3. An implication graph of the compatible pairs.
4. The set of maximal compatibles.
5. A reduced covering table showing merged states on the right (similar to Unger Table 2.5).
6. The state variable assignments that you use for your merged states.
7. The karnaugh map for deriving the logic equations for each of the designs.
8. The final boolean equations, in sum-of-products form, for your implementation.

Include a short description of any observations you made of the design process and conversion
of the specification into an implementation.

Make any observations about the potential for hazards in your design based on Table 4.3.