CS2100 Computer Organisation

Lab 10: Decoder & Multiplexer (Week 9th November)

Instruction

Short and clean
We have separated the lab information into i) **instruction** and ii) **report**. Whenever there is a question in the instruction (easily identified as they have **[X pts]** tagged to the end), write / type your answer in the corresponding location in the **report** document. Please take note of the submission specification at the end of this document.

Objectives:

- Learn how to use a decoder to implement Boolean logic function.
- Learn how to use a multiplexer to implement Boolean logic function.

Procedure:

1. Design a four-variable Boolean function *F(P,Q,R,S)* that outputs 1 if the input *PQRS* is a Fibonacci number. Fibonacci sequence is 1, 1, 2, 3, 5, 8, ….. Two outputs are already filled for you in the truth table. Complete the truth table for *F* in the report. **[4 pts]**

2. Using a 4x16 decoder with **active low** output, provide an implementation for F using one suitable gate **with the smallest fan-in** possible. Use the provided partial circuit "**`Use Decoder.dig`**" to finish the implementation. You can right-click on a logic gate to increase the fan-in.

   Include the circuit drawing (either hand drawn or screenshot) in your report **[4 pts]**

3. Using an 8:1 multiplexer, provide two alternative solutions and fill in the multiplexer inputs in the respective diagrams in the report. If an input is complemented, for example, *P*′, you may write *P*′ directly.

   a. Implement function *F* using *QRS* as the selector lines. **[2 pts]**

   b. Implement function *F* using *PQR* as the selector lines. **[2 pts]**

   Use the provided partial circuit "**`Use Multiplexer.dig`**" to implement approach **3a** above.

4. Show your implementations from *Step 2* and *Step 3a* to your lab TA. **[4 pts]**

You need to submit into Luminus Folder no longer than **2359 on the same day** you have the online lab. Please rename the **report document** with your student id: **[student_id]_lab010.docx** or **[student_id]_lab10.pdf**, e.g. **A1234567X_lab10.pdf**. Submit into the correct folder on Luminus before 2359 of your lab day.
Marking Scheme: Report – 12 marks; Demonstration – 4 marks; Total: 16 marks.