The Chinese University of Hong Kong
Department of Computer Science and Engineering
CENG2010 Digital Logic Design Laboratory

Lab 1: Introduction to VHDL

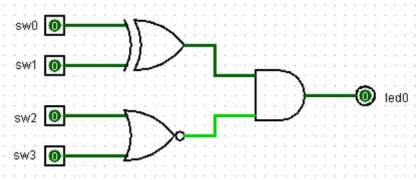
Submission Instructions:

- You are required to submit **BOTH <u>demo videos</u>** and **<u>VHDL codes</u>** to Blackboard.
- Create each VHDL project with a project name based on the lab and question number, e.g. "**ceng2010_lab1_q2**".
- Zip all the project folders to ONE single zip/rar file named with your student ID number, e.g. "**1155123456.zip**".
- Upload the zip/rar file to Blackboard before the deadline stated in Blackboard
- Marks will be deducted for late submission, deduct 10 marks per every 30-minute interval

For each question below, you are required to record a short mp4 video to demonstrate the answers. In the video, the following elements are required:

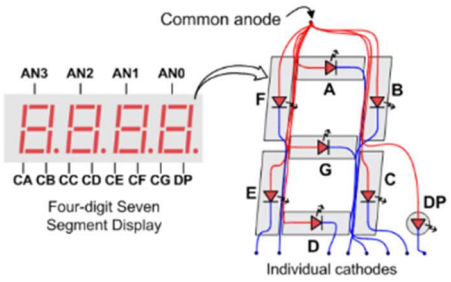
A. Next to your FPGA board, show your full name and SID (e.g. your student ID card) [5 marks]
B. Voice descriptions in English/Cantonese/Mandarin on what you are doing [5 marks]
C. Demonstrate works by presenting all possible input combinations step-by-step clearly [30 marks]

1. Given the following combinational logic circuit:
   a. Implement the circuit using VHDL. Use four switches (i.e. sw0 to sw3) as the inputs, and use one LED (i.e. led0) as the output. [20 marks]



2. Using VHDL, turn on the LEDs (i.e. led0 to led7) by the switches (i.e. sw0 to sw7) in the following manners:
   a. led0 will be ON when sw0 is ON
   b. led1 will be ON when sw1 is ON
   c. led2 will be ON when either sw2 **or** sw3 is ON
   d. led3 will be ON when both sw2 **and** sw4 are ON
   e. led4 will be ON when sw4 is OFF
   f. led5 will be ON when sw5 is OFF
   g. led6 will be ON when sw4 is ON **and** sw5 is OFF
   h. led7 will be ON when sw4 **and** sw7 are ON, **and** either sw5 **or** sw6 is ON [20 marks]

3. There is a four-digit **common anode** seven-segment LED display on the Basys3 board. Each of the four digits is composed of eight LEDs (including 7 segment LED and 1 decimal point LED).
   a. Using VHDL, light up/down the LED segments (i.e. seg0 to seg6, and dp) of **the right-most digit only** of the 7-segment display by using 8 switches (i.e. sw0 to sw7). [20 marks]



Hints: In order to light up a particular segment of a particular digit…
   i. Output a '0' or '1' to enable or disable respectively the active-low common anode of that digit (i.e. **an0** for digit0 (the right-most digit), an1 for digit1, an2 for digit2, and an3 for digit3 (the left-most digit)).
   ii. Output a '0' or '1' to light up or out respectively that segment of the digit (i.e. **seg0** for A, **seg1** for B, **seg2** for C, **seg3** for D, **seg4** for E, **seg5** for F, **seg6** for G, **dp** for **DP**).

THE END