Grading Rubric for ECE 2031 Lab Results

NOTE: This grading rubric is not comprehensive. The most common errors are listed, but students may make errors not listed here and deductions may be applied. Ask questions when unsure.

General Guidelines for Lab Results
- Assignment must have check-off sheet and filled-out evaluation sheet (name, section, date, signature) to be accepted. Lab results with incomplete check-offs ARE accepted, but no check-off = no points for that result.

- All figures, tables, and code should be computer generated and labeled unless specified as “hand annotated” or “worksheet” in the submission specification.

- Each set of lab results includes 50 points for proper formatting. The grading rubric for formatting is contained below, along with a list of common formatting errors that will result in point deductions. This does not include point deductions for technical errors, which come from a separate 100-point category.

- For labs where results are built upon earlier results (e.g. a schematic is created from a K-map)—if technical errors occur are propagated, point deductions will be taken on the first result, not on each result where the error is present. Formatting errors are counted for each occurrence.

Point Deductions for Common Non-formatting Errors

-5 missing pin numbers (always include pin numbers, whether DIP or FPGA pins)
-1/2 credit (per result) late pre-lab check-offs (any prelab check-offs received after X:20 of the first hour of lab)
-1/2 credit (per result) figure/table title is wrong/inaccurate, demonstrating lack of understanding of result (even if result is correct), e.g. calling a combinational circuit a state machine, or calling VHDL assembly code

Point Deductions for Formatting Errors

-5 results out of order (follow order listed in the submission specification)
-50/N results missing a caption on an individual result, or no formatting applied to caption
General formatting errors: -2 points each

Next page describes some common formatting errors to avoid.
### Common Formatting Errors

<table>
<thead>
<tr>
<th>Error Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>failure to turn off grid (dots appear in background of figure)</td>
</tr>
<tr>
<td>failure to crop out unnecessary or useless info/space from a screen capture or figure, such as toolbars, scroll bars, and empty space</td>
</tr>
<tr>
<td>cropping out necessary information, such as waveform types and labels or relevant parts of waveforms</td>
</tr>
<tr>
<td>incorrect alignment of formatted objects on the printed paper (e.g., overlapping figure and title, figure and title too far apart, objects outside of printing area or objects “cut off” when printed)</td>
</tr>
<tr>
<td>graphics/labels too small</td>
</tr>
<tr>
<td>images stretched/skewed (always preserve original aspect ratio of technical images)</td>
</tr>
<tr>
<td>missing title box on schematics</td>
</tr>
<tr>
<td>incomplete or ineffective comments in code, including missing header lines</td>
</tr>
<tr>
<td>code not in fixed-width font, or with extra line spaces</td>
</tr>
<tr>
<td>improper capitalization in title/caption</td>
</tr>
<tr>
<td>spelling errors</td>
</tr>
<tr>
<td>missing or incorrect use of punctuation in title/caption</td>
</tr>
<tr>
<td>missing or incorrect use of bold</td>
</tr>
<tr>
<td>document or page(s) stapled in incorrect location</td>
</tr>
<tr>
<td>vague title or caption</td>
</tr>
</tbody>
</table>

**Avoid:** “Worst case propagation for circuit.” Or “Rise time of Y.” These titles are too vague. What is the circuit? Name it. What is Y? Describe it.

**Avoid:** “Schematic of the circuit in Lab 2 step 4.” Name/describe the circuit and avoid referring to the lab manual. The reader doesn't know what Lab 2 is or what you did in step 4.

**Avoid:** Referring to figure #s in subsequent results, e.g., “The circuit from Figure 1 with additional functionality.” Each figure should stand alone and should be self-contained so that the reader fully understands the information based on the caption. All figures should be labeled descriptively, even if several figures show the same circuit. Describe the circuit and important information in each figure caption.
Examples of Properly and Improperly Formatted Figures, Tables, and Code

The examples and guidelines provided here follow a subset of IEEE formatting guidelines, and can be applied to all engineering documents in GaTech ECE, including lab results (printouts of schematics, screen captures, tables, and code corresponding to the weekly labs), and larger documents (proposals, final reports, etc.).

Example #1. Properly formatted schematic and label

Note: The schematic is large enough so that all pin numbers, inputs, and outputs can be clearly seen. There is no way to resize the title box in Quartus, so don’t worry that it seems a bit overpowering. The title box should always be placed in the lower right corner of the figure.

Figure 1. Schematic of circuit implementing $Y = (A \cdot B) + C$.

* Labels that fit on one line are centered. Labels that require two or more lines are left-justified.
Example #2. Improperly formatted schematic

The following figure is the same circuit as in Figure 1, but with many formatting errors.

**Label errors:**

1. In wrong place – above image and not centered
2. ‘Figure’ not capitalized
3. ‘Figure’ not spelled out
4. Figure number out of order (should be 2 in this document)
5. ‘Figure 4’ not bold
6. No period after ‘4’ (hyphen used instead)
7. ‘Step’ not capitalized
8. Caption is not detailed, and refers to lab manual
9. Unnecessary capitalization of ‘Result’
10. Spelling error
11. No period at end

**Figure errors:**

1. Improper cropping
2. Grid in background (dots)
3. Too small to read
4. Title block in wrong place
5. Title block not filled out

This figure would be considered “no formatting” and count off the prorated number of formatting points, in addition to 5 technical points for missing pin numbers.
Example #3. Properly formatted landscape figure and label

You can orient your figures using portrait or landscape. Use landscape if the image is too large to fit in portrait and remain legible. When including a landscaped figure with other results, label the figure so that the title caption is on the right-hand side of the page when the page is vertical. The staple would still be in the left corner. This configuration is standard and allows the reader to turn the previous pages away from them instead of towards them.

![Simulation waveform of example state machine showing all possible state transitions, and assertion of Z during state C.](image)

Figure 3. Simulation waveform of example state machine showing all possible state transitions, and assertion of Z during state C.

Notes for waveforms:
Use appropriate number radix (usually binary or hexadecimal).
Ensure that the signal names and type (input/output), time bar, and the entire significant portion of the waveform are visible.
Crop out the scroll bars, toolbars, and window.
Either delete or (as here) move the time cursor to 0s (unless it is being used to mark a relevant feature of the waveform).
Example #4. Properly labeled and formatted code (less than one page in length)

Figure 4 is an example of properly formatted code that spans \textbf{less than a page}. Always place header comments in the first lines of every piece of code submitted, as shown below. Be sure to use a fixed-width font such as \texttt{Courier New} for code, and remove extra space between lines (Microsoft Word defaults to 1.15 line space)

```vhdl
-- ORGATE.VHD (VHDL)
-- This code produces a negative-logic OR circuit
-- George P. Burdell
-- ECE2031 L01
-- 01/31/2009

LIBRARY IEEE;
USE IEEE.STD_LOGIC_1164.all;

ENTITY orgate IS
PORT(
    PB1, PB2 : IN STD_LOGIC;
    LED : OUT STD_LOGIC);
END orgate;

ARCHITECTURE a OF orgate IS
BEGIN
    LED <= NOT(NOT PB1 OR NOT PB2);
END a;
```

\textbf{Figure 4.} Negative-logic OR gate VHDL code.

Code always contains header lines

Code that is less than one page is formatted as a figure
Example #5. Properly formatted table

Below is an example of a properly formatted table. The title is **above** the table with the table number on its own line. Use small-caps style font (an option in the font style settings of any major word processor) and capitalize the first letter of each major word. There is **no period placed after the table number or at the end of the title**.

```
<table>
<thead>
<tr>
<th>Q1</th>
<th>Q0</th>
<th>X1</th>
<th>X0</th>
<th>Next</th>
<th>Q1+</th>
<th>Q0+</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>A</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>C</td>
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</tr>
</tbody>
</table>

TABLE 1

STATE TRANSITION TABLE FOR STATE MACHINE ABC

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</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>C</td>
<td>1</td>
<td>0</td>
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<tr>
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<td>1</td>
<td>0</td>
<td>B</td>
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<td>d</td>
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</tr>
</tbody>
</table>
```

For tables, use small-caps style font and capitalize the initial letter of each major word in the title. **No period at the end of table titles**.
Example #6. Properly labeled Karnaugh maps

Below are examples of properly labeled Karnaugh maps. They can be formatted as either a figure or a table. Make sure to circle the appropriate terms.

Note: Unless the result specifications state “hand annotated” or “worksheet,” all figures and tables should be computer generated.

**Figure 5.** Example of a Karnaugh map implementing $\overline{A} \overline{C} + AB$. Because this figure label is longer than one line, it is left-justified, instead of centered.

**TABLE 2**
KARNAUGH MAP WITH SUM-OF-PRODUCTS MINTERMS MARKED
Example #8. Code that spans more than one page

When code spans longer than one page in length, it should be NOT be labeled as a figure (i.e., don’t put “Figure X: VHDL code” at the bottom of each page). Instead, treat each set of code as a separate Appendix by creating a cover page that describes the code. Then include all of the pages of code after the cover sheet. If you have multiple sets of code, you would have several Appendices (A, B, C, etc.). The title on the cover page of each Appendix should be centered as shown below. Remember to use fixed-width font for code.

Code should ALWAYS be commented so that the reader understands how the code works.

Appendices ALWAYS go at the end of the document, regardless of result order.

Appendix A: Example Long Code
LIBRARY IEEE;
USE IEEE.STD_LOGIC_1164.all;
USE IEEE.STD_LOGIC_ARITH.all;
USE IEEE.STD_LOGIC_UNSIGNED.all;

ENTITY keyboard IS
  PORT(
    keyboard_clk, keyboard_data, clock_25Mhz, reset, read : IN STD_LOGIC;
    scan_code : OUT STD_LOGIC_VECTOR(7 DOWNTO 0);
    scan_ready : OUT STD_LOGIC);
END keyboard;

ARCHITECTURE a OF keyboard IS
  SIGNAL INCNT : std_logic_vector(3 downto 0);
  SIGNAL SHIFTIN : std_logic_vector(8 downto 0);
  SIGNAL READ_CHAR : std_logic;
  SIGNAL INFLAG, ready_set : std_logic;
  SIGNAL keyboard_clk_filtered : std_logic;
  SIGNAL filter : std_logic_vector(7 downto 0);
BEGIN
  PROCESS (read, ready_set)
  BEGIN
    IF read = '1' THEN scan_ready <= '0';
    ELSIF ready_set'EVENT and ready_set = '1' THEN
      scan_ready <= '1';
    END IF;
  END PROCESS;

  --This process filters the raw clock signal coming from the keyboard using a shift register and two AND gates
  Clock_filter: PROCESS
  BEGIN
    WAIT UNTIL clock_25Mhz'EVENT AND clock_25Mhz = '1';
    filter (6 DOWNTO 0) <= filter(7 DOWNTO 1);
    filter(7) <= keyboard_clk;
    IF filter = "11111111" THEN keyboard_clk_filtered <= '1';
    ELSIF filter = "00000000" THEN keyboard_clk_filtered <= '0';
    END IF;
  END PROCESS Clock_filter;

  --This process reads in serial data coming from the terminal
  PROCESS

BEGIN
WAIT UNTIL (KEYBOARD_CLK_filtered'EVENT AND KEYBOARD_CLK_filtered='1');
IF RESET='1' THEN
  INCNT <= "0000";
  READ_CHAR <= '0';
ELSE
  IF KEYBOARD_DATA='0' AND READ_CHAR='0' THEN
    READ_CHAR<= '1';
    ready_set<= '0';
  ELSE
    -- Shift in next 8 data bits to assemble a scan code
    IF READ_CHAR = '1' THEN
      IF INCNT < "1001" THEN
        INCNT <= INCNT + 1;
        SHIFTIN(7 DOWNTO 0) <= SHIFTIN(8 DOWNTO 1);
        SHIFTIN(8) <= KEYBOARD_DATA;
        ready_set <= '0';
        -- End of scan code character, so set flags and exit loop
      ELSE
        scan_code <= SHIFTIN(7 DOWNTO 0);
        READ_CHAR <='0';
        ready_set <= '1';
        INCNT <= "0000";
      END IF;
    END IF;
  END IF;
END IF;
END PROCESS;
END a;
Tips for Writing Effective and Descriptive Figure/Table Captions

- The purpose of a figure title is to explain to the reader why the figure is important
- The title/caption for each table or figure in your document will be unique
- There is more than one effective way to describe a figure or table
- Included here in quotes are not full titles, but example snippets of titles/captions

Circuit Schematics

1. If you built the circuit to perform some function, include it in the title
   a. “Y = A'+B'C”
   b. “Output ‘happy’ is active when either input ‘playing’ or ‘eating’ is active”
   c. "4-bit full adder"
2. If there is a special characteristic of the schematic, include it in the title
   a. "Showing the path with worst-case propagation delay"
   b. “with clock c5 attached to device dff3”

What is NOT Needed

1. Naming every component of the schematic
   a. NO! “with two AND gates and three NOT gates”
2. Telling us which lab/lab-step the circuit is associated with
   a. NO! “The schematic for the circuit from pre-lab step 4”
3. Relying on other figures/lab manual for descriptions
   a. NO! “Schematic circuit for Truth Table in Table 2”
   b. NO! “Lab 2 circuit schematic”
   c. NO! “Circuit from Figure 1 with worst-case path from pre-lab step 3”

Oscilloscope Captures

1. Explain where the signals come from. Similar to circuit schematics, name the circuit.
   a. "The output of breadboard circuit implementing Y = A'+B'C"
   b. "The output of unknown circuit in <filename> running on a DE2 board"
2. If applicable, describe what type of signal are we looking at
   a. "A square/sine/sawtooth wave"
3. Tell us what is being measured
   a. "The rise time of "
   b. "The period of "
4. If what you are measuring is not immediately apparent on the graph, include its value in your title
   a. "A duty cycle of 33%"

5. If you have multiple signals, differentiate between them by color/position*
   a. "V1 (dark blue) and V2 (light blue)"
   b. "V1 (top) and V2 (bottom)"

*This will depend on how the signals are arranged on the scope, and if you print in color or b&w

**Tables**

1. Describe the table contents. If it's a Truth Table, explain the logic
   a. "Truth Table of Y = A' + B' + C"
   b. "Propagation Delays of Texas Instruments ICs"
   c. "Karnaugh Map Producing Y = A' + B' + C"

2. Include any special characteristics
   a. "with Highest Propagation Delays Highlighted"
   b. "Annotated to Show Delays"

**Simulation Waveforms**

1. Describe what is being simulated
   a. “Circuit implementing …”
   b. “Decoder for I/O devices”

2. Include important features of the simulation
   a. “for all possible input combinations”
   b. “receiving data values 0x34 and 0x22”
   c. “showing final value of 0xFFFF”
   d. “with decoded opcode values for the first three instructions of example.asm”