

Exam instructions:

1. No exams will be graded if you violated any of the exam instructions.
2. Feel free to use your book or your class-notes, but you are **NOT** allowed to use any form of communication with any classmate.
3. There are two questions, and I only accept a report with 5 pages. Use the font `Courier New` for your report.
4. The first question must fit in two pages, with the first page containing the waveform and the second page containing the source-code.
5. The second question must fit in three pages, with the first page containing the waveform, the second page containing the source-code and the third page containing your test-bench.
6. Put these in a word document and email them to nalves@wne.edu. Label each question and make sure I am able to copy and paste your code into active HDL so I can simulate it.

Grading:

1. There are two questions, each worth 50 points. Full credit is awarded if the wave-form is for each question is flawless, and if you followed all the directions.
2. Points will be deducted from each question if there are any wave-form inconsistencies:

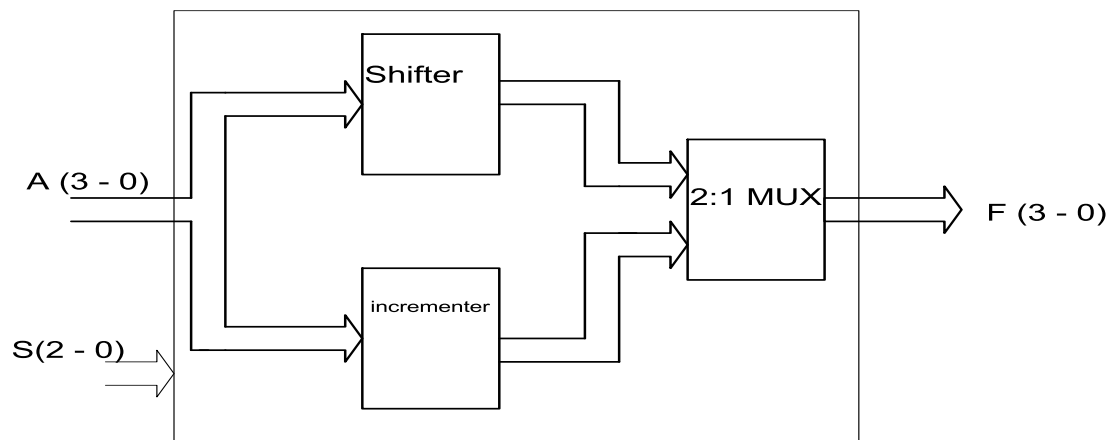
Directions were followed	Directions were not followed	Deduction
<ul style="list-style-type: none"> • Close to the desired solution • Code compiles 		10
<ul style="list-style-type: none"> • Far from the desired solution • Shows general understanding • Code compiles 	<ul style="list-style-type: none"> • Close to the desired solution • Code compiles 	20
<ul style="list-style-type: none"> • Code does not compile • Shows general understanding 	<ul style="list-style-type: none"> • Far from the desired solution • Shows general understanding • Code compiles 	35
<ul style="list-style-type: none"> • Code does not compile • Shows very little understanding 	<ul style="list-style-type: none"> • Very far from desired solution regardless of code compilation 	50

Question 1 - Create a circuit in VHDL that will implement the following functionality:

- There is one 4-bit data input 'A' that goes to both the shifter and the incrementer.
- The outputs of the shifter and incrementer are 4-bits wide, and 'F' is 4 bits.
- There is also a 3-bit control input S(2 – 0). S(1) and S(0) control the functions of the shifter and incrementer, as described below.
- S(2) controls the 4-wide 2:1 MUX that provides the output. If S(2) = 0 the shifter output goes to 'F'; if S(2) = 1 then incrementer output goes to 'F'.

The diagram below shows the data flow; the control signal connections are not shown. Test the circuit with the test-bench provided. You may NOT modify the test-bench, so make sure you use the appropriate signal names and signal data-types.

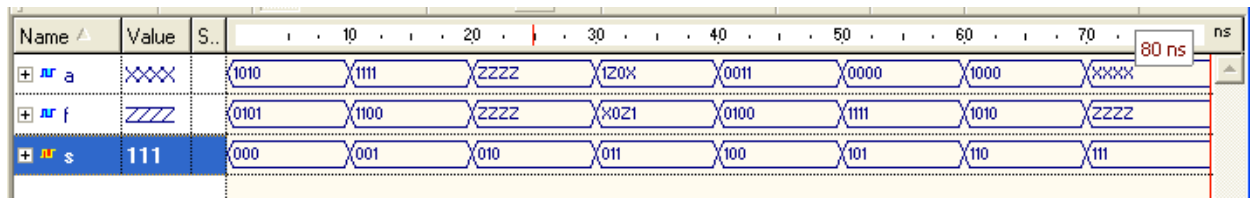
Important: Set all inputs/outputs on your wave-form to be displayed in binary, simulate your circuit for 80 ns and fit the entire waveform on the screen (use the fit-to-screen option).



S(1)	S(0)	Shifter function	Incrementer function
0	0	A shift right 1 bit	A + 1
0	1	A shift left 2 bits	A - 1
1	0	A (unchanged)	A + 2
1	1	Reverse order of bits *	High Impedance

* Example: If A="1Z0X", the output of the shifter function should be "X0Z1".

This is the output you should get:

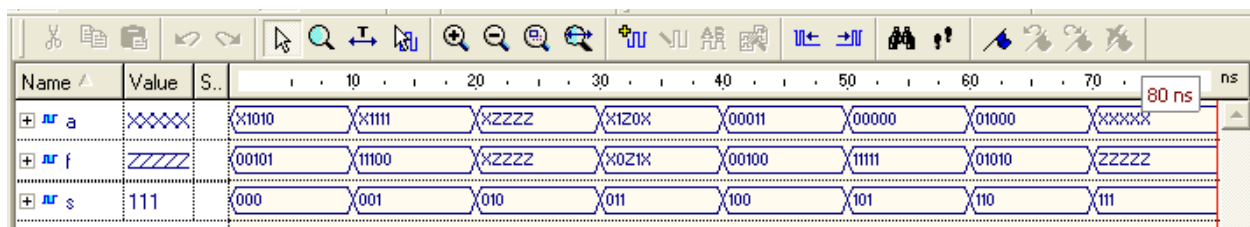


Question 2 - In question 1, the size of the bus 'A' and 'F' were hardwired to 4 bits. Set the generic attribute to accommodate a bus size of 5 bits.

- Modify your source code from question 1 and make the input signal 'A' and the output signal 'F' truly generic. That is, ensure your program will work for an input/output bus of any size, using the **GENERIC** attribute.
- Set the generic attribute such that 'A' and 'F' both have a length of 5 bits.
- Modify the test-bench used in question 1 so that it will work with your generic implementation.
- In your test-bench you may change the input vectors for the signal 'A'.
- In your test-bench you may **NOT** modify the input vectors for the signal 'S'!

Important: Set all inputs/outputs on your wave-form to be displayed in binary, simulate your circuit for 80 ns and fit the entire waveform on the screen (use the fit-to-screen option).

This is one possible output you could get.



Grading worksheet

Question #1

Directions were followed	Directions were not followed	Deduction
<ul style="list-style-type: none">• Close to the desired solution• Code compiles		10
<ul style="list-style-type: none">• Far from the desired solution• Shows general understanding• Code compiles	<ul style="list-style-type: none">• Close to the desired solution• Code compiles	20
<ul style="list-style-type: none">• Code does not compile• Shows general understanding	<ul style="list-style-type: none">• Far from the desired solution• Shows general understanding• Code compiles	35
<ul style="list-style-type: none">• Code does not compile• Shows very little understanding	<ul style="list-style-type: none">• Very far from desired solution regardless of code compilation	50

Question #2

Directions were followed	Directions were not followed	Deduction
<ul style="list-style-type: none">• Close to the desired solution• Code compiles		10
<ul style="list-style-type: none">• Far from the desired solution• Shows general understanding• Code compiles	<ul style="list-style-type: none">• Close to the desired solution• Code compiles	20
<ul style="list-style-type: none">• Code does not compile• Shows general understanding	<ul style="list-style-type: none">• Far from the desired solution• Shows general understanding• Code compiles	35
<ul style="list-style-type: none">• Code does not compile• Shows very little understanding	<ul style="list-style-type: none">• Very far from desired solution regardless of code compilation	50

Total score: