Name_____

EECS 452 Theory Exam

March 27, 1998

Closed book- do 5 out of 6 questions

1. Quantizers are important in fixed point DSP applications. A good design has as few as possible and places them in locations where they are least harmful.

   a. Compare the direct form II and its transpose form with respect to the number of quantizers they have and

   b. Explain why the transpose form may be the better performer.

2. Several changes were made by Texas Instruments in moving from the C2x chip to the C5x chip. One of the most conspicuous was the addition of a second double register next to the accumulator. The contents of the two registers can be exchanged with a single instruction thus making it useful as temporarily storage. Discuss how this small investment of silicon area can increase the value of the processor.

3. A block calculated algorithm such as the overlap and add or overlap and save FIR filtering algorithm are often coupled with input and output functions which clock data in and out of the processor at a constant rate. The first-in-first-out (FIFO) circular buffer is often used to make sure that the two types of operation work smoothly together. For the parts below, assume that the FIR filter uses a 256 point FFT to achieve filtering with a 51 point FIR filter and that the sample rate is 15 kHz. for both input and output.

   a. Create a block diagram of the data flow through such a system. The data come in at a constant rate, are filtered with a block coded FIR filter algorithm and go out the same constant rate as the input. Show the flow diagram with enough detail to demonstrate the movement of data.

   b. What is the minimum delay from input to output in such a system assuming that all computation is instantaneous?

   c. Assuming that the FFT must be done twice per data cycle and that it is dominate consumer of processor time, how much time does it have to perform its conversion?

   d. How does the FFT process time effect the delay time?

   e. List the properties of addressing modes which allow easy implementation of the buffers.

4. Assume 2’s compliment arithmetic for the following.

   a. Taking note of the binary point positions, multiply the following two six bit binary numbers together (100111. and 10.0100). Give the result in binary with the binary point in the correct location. Hint: Be sure to use sign extended numbers within your

multiplication operation

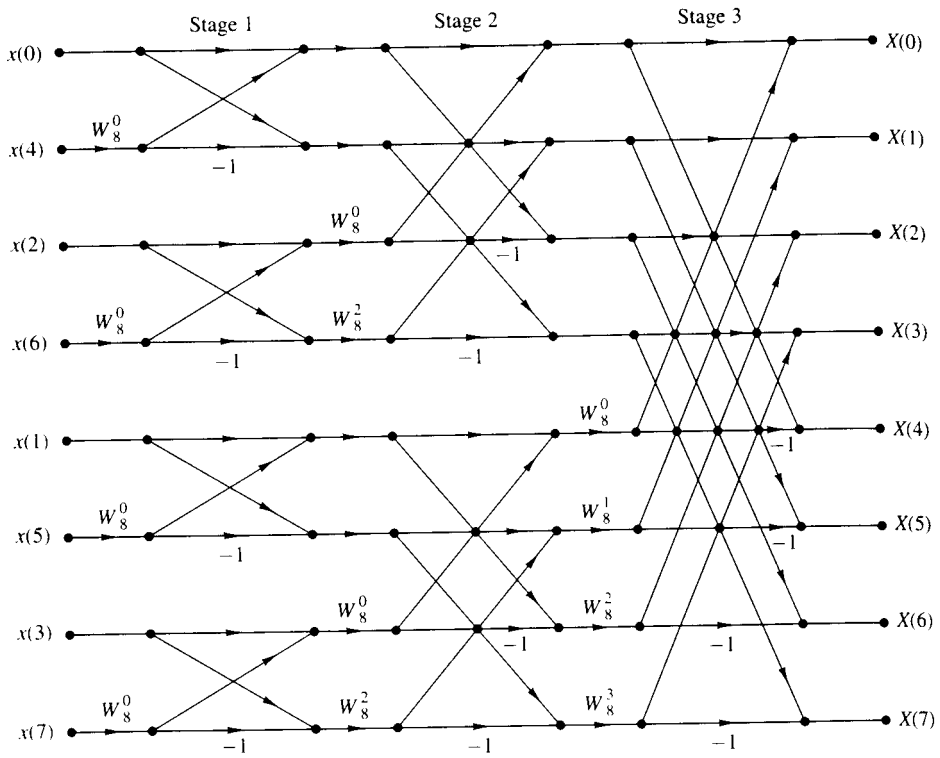
b. The 12 bit binary number with binary point (0000.01001101) is to be stored in a six bit register with a arithmetic left shift of three places. Evaluate:

   i. The value of the binary number before storage

   ii. The value after storage

5. The eight point time sequence {2 1 0 1 2 1 0 1} is to be transformed to the frequency domain by the decimation in time FFT algorithm. Place the sequence in the column marked $x_{BR}(n)$ below in bit reversed order. Proceed to fill in the other columns until the transform of the sequence $X(k)$ appears on the right. Both the input and output sequences are simple enough to guess so you should know when you have the right answer.

$x_{BR}(n)$			$X(k)$


Stage 1
Stage 2
Stage 3
x(0)
x(4)
x(2)
x(6)
x(1)
x(5)
x(3)
x(7)
X(0)
X(1)
X(2)
X(3)
X(4)
X(5)
X(6)
X(7)
W_8^0
W_8^2
W_8^1
W_8^3
−1