NAME: _____ GRADE: _____

EE442 / EE592 Real-Time Digital Signal Processing
Quiz #2
Allowed: *Course Textbook*, Calculators

Each question is worth 10 points unless otherwise noted.

1. Consider a digital filter whose I/O difference equation is given by

$$y[n] = x[n-2] + 0.5y[n-2].$$

For the input signal

$$x[n] = \delta[n] + 2\delta[n-1] + 3\delta[n-2] + 4\delta[n-3].$$

Determine the output signal for $0 \le n \le 6$.

2. Suppose we have a value in accumulator a. Write a code which will compute the signum of a, sgn(a):

```
if a < 0
   a = –1.0
elseif a = 0
   a = 0.0
else
   a = 1.0
end;
```

3. Consider the **pass.dat** file in the Modified Pass Pack on p. 324 of the text. As configured, there are 7K words of on-chip X memory from X:$0000 – X:$1BFF with addresses X:$000A – X:$0009 reserved for the codec. What is the longest circular array that can be stored in on-chip X-memory?

Write a code for the following real-time programming tasks (Questions 4 – 6, 9), assuming the Modified Pass Pack beginning on p. 324 of the text. Identify by file name (**pass.asm**, **pass.dat**, **proginit.asm**, and **procster.asm**) and line number where you would place your instructions. The first programming task is done as an example.

4. Write a code which multiplies the right channel by $g = 0.7$.

Solution:

In **pass.dat** insert after line 10 the following line:

```
g   equ   0.7
```

In **procster.asm** replace the NOP the following line:

```
   mpyr   #g,x0,a   ;multiply right sample by g and round
```

In **pass.asm** replace line 74 with the following line:

```
   move   a,x:TX_BUFF_BASE    ;transmit right sample
```

5. Write a code which will create and zero out a circular queue (delay line) of length 10,000 samples.

6. Using your code in Question 5, write additional code which computes

$$y[n] = x[n] + 0.5x[n-1] + 0.25x[n-10000]$$

for *left-channel* input samples (your output should be sent to the left channel of the D/A).

7. Reverse-engineer the following code and determine the difference equation which is being implemented.

In **`pass.dat`** insert after line 10 the following line

```
N   equ   300
```

and after line 40 the following lines:

```
TAPSPACE   dc    100,200,300
TAPGAIN    dc    0.5, 0.25, 0.125
INPUT      dsm   N
```

In **`proginit.asm`** replace the NOP with the following lines:

```
   move #INPUT,r0
   move #N-1,m0
   move #$0,x0
   rep #N
   move x0,x:(r0)+
```

In **`procster.asm`** replace the NOP the following lines:

```
   move #TAPSPACE,r1
   move #TAPGAIN,r2
   move x0,a
   do #3,end
   move x:(r1)+,n0
   move x:(r0+n0),x1
   move x:(r2)+,y1
   mac  x1,y1,a
end
   rnd  a   x0,x:(r0)-
   move a,x0
```

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8. For the digital filter given in Question 1,

(a) Draw a Direct Form (DF) I realization of the difference equation.

(b) Draw a DF II realization of the difference equation.

(c) Write the state equations for the DF II realization.

9. Using the Modified Pass Pack and your results in Question 8, write a code which filters the left channel.