

NAME: _____

GRADE: _____

EE492 / EE592 Real-Time Digital Signal Processing
Quiz #2
Open Books, Notes, Calculators (no programs, no graphing)

Suppose the impulse response of a digital filter is given by

$$h(n) = \delta(n) + 4\delta(n-1) + 6\delta(n-2) + 4\delta(n-3) + \delta(n-4)$$

and the input is given by

$$x(n) = \delta(n) + 2\delta(n-1) + \delta(n-2).$$

Compute the following in Questions 1 – 4.

1. Compute the filter output

$$y = h * x$$

2. Let

$$h_1(n) = h(n-2)$$

Compute the filter output

$$y_1 = h_1 * x.$$

3. Let

$$h_2(n) = h(n+2)$$

Compute the filter output

$$y_2 = h_2 * x.$$

4. Let

$$h_3(n) = h_1(n) + h_2(n)$$

where $h_1(n)$, $h_2(n)$ come from the above questions. Compute the filter output

$$y_3 = h_3 * x.$$

5. Suppose we have two values in registers x0 and y1. Write a code which will perform the following steps:

```
if x0 ≠ y0
    x0 = y0
else
    x0 = 0
end
```

Write a code for the following programming tasks (Questions 6 - 9), assuming the Modified Pass Pack beginning on p. 307 of the text. Identify by file name (PASS.ASM or PASS.DAT) and line number where you would place your instructions. The first programming task is done as an example.

6. 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 PASS.ASM insert at line 82 the following line:

```
move    #g,x1    ; move g to x1
```

In PASS.ASM replace lines 98 – 100 with the following lines:

```
mpyr    x0,x1,a ; multiply right sample by 0.7, rounded result in a
move    a,x0    ; move result to x0 for move to TX_BUFF_BASE in loop_1
```

7. Suppose we add the following lines to PASS.dat:

```
line 11: N    equ    900
line 78: DELAYLINE    dsm    N
```

Write a code which points R0 to DELAYLINE, sets M0 for circular addressing, and clears the DELAYLINE out prior to entering the main event loop (loop_1).

8 (25 points) Assume code from the previous problem. Suppose we also add the following lines to PASS.dat

```
line 41: TAPSPACE    dc    0, 100, 200, 300, 400, 500, 600, 700, 800, 900
line 42: TAPGAIN     dc    0.1, 0.2, 0.3, 0.4, 0.5, -0.5, -0.4, -0.3, -0.2, -0.1
```

Write a code which will insert the current left channel sample into the DELAYLINE and then compute the output of the tapped delay line, according to the given TAPSPACE and TAPGAIN data, i.e.

$$y(n) = \sum_{k=1}^{10} \text{TAPGAIN}_k \times x(n - \text{TAPSPACE}_k)$$

where $x(n)$ is the current left channel sample and $y(n)$ is the output. Also send the output to the D/A (left channel).

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9. (25 points) Write a code which implements the Direct Form II (Canonical Form) of the following difference equation for the right channel

$$y(n) = -0.25y(n-1) + x(n) - 0.5x(n-2)$$