EE442 / EE592 Real-Time Digital Signal Processing
Quiz #4
Allowed: Books, Code Printouts, Calculator, and Notes

Each question is worth 10 points unless otherwise noted.

1. What Texas Instruments processor and development board are we using?

2. In the DSPFixedPointFunctions, we frequently use cdelay(). Please explain why we use cdelay.

   Explain (with details), why we call cdelay() as
   
   cdelay(short D, short *w, short **p)

   instead of
   
   cdelay(short D, short *w, short *p)

3. Fill in the table

<table>
<thead>
<tr>
<th>Parity Type</th>
<th>Data</th>
<th>Parity Bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1010101</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Odd</td>
<td>0101010</td>
<td></td>
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<tr>
<td></td>
<td>1100110</td>
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<td>Odd</td>
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<td></td>
<td>1010101</td>
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<td>Even</td>
<td>0101010</td>
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<td></td>
<td>1100110</td>
<td>1</td>
</tr>
<tr>
<td>Even</td>
<td>0011001</td>
<td></td>
</tr>
</tbody>
</table>
4. Provide the value, \( z \) for the following code

```c
short x, y, z;
void main (void)
{
    x = -16000;
    y = 17000;
    z = x - y;
}
z = ?
```

5. Provide the value, \( z \) for the following code

```c
short x, y
int z;
void main (void)
{
    x = 8192;
    y = 16384;
    z = (x * y) >> 15;
}
z = ?
```

6. Write a code (similar to that in Problem 5) that will compute the following for a fixed-point processor:

\[
\begin{bmatrix}
1 & 2 & 3 \\
4 & 5 & 6
\end{bmatrix}
\]

Your result \( z \) should be rounded and returned as a short. Finally, you may use functions in DSPFixedPointFunctions.
7. In all of the DSP routines involving a circular array to store filter states, the array w and the oldest filter state p are passed as input arguments. For example

```c
short cfir(short M, short *h, short *w, short **p, short x)
```

is called in `process_signal()` with

```c
*outputRight = cfir(FILTERORDER, coeffs, states, &oldestStatePtr, inputRight);
```

Please explain why

```c
short cfir(short M, short *h, short *w, short *p, short x)
```

and

```c
*outputRight = cfir(FILTERORDER, coeffs, states, *oldestStatePtr, inputRight);
```

will not properly implement a circular array.
8. Write a function `comb()` which implements the comb filter from Project #1. The state equations are given on p. 170:

\[
\begin{align*}
  w_0[n] &= x[n] + gw_m[n] \\
  y[n] &= w_m[n] \\
  w_k[n + 1] &= w_{k-1}[n], \quad k = m, m - 1, \ldots, 1
\end{align*}
\]

Solution:
9. Consider the lookup.wavIntDelta.c and lookup.wav.c functions for wavetable synthesis. Assume 256 samples of a sinusoid (tone) are stored in a table and $f_s = 16,000$ samples/s.

(a) For synthesis of a 1125 Hz tone, determine the value delta (short) that will be used as input to lookup.wavIntDelta.

(b) For synthesis of a 440 Hz tone, determine the value delta (int) that will be used as input to lookup.wavIntDelta.