

R9

Date: _____; Time: 3 hours; Full Marks: 70; Number of Students 71

Spring Semester, 2009; Department: E & ECE; Subject code EC 33008

III year B. Tech.;

Subject name: Digital Signal Processing

Instruction: Answer all questions. Answers should be clear and to the point.

All parts of the questions should answered in one place, else it will not be marked.

1. The FFT requires the multiplication of complex numbers

$$(a_1 + jb_1) \cdot (a_2 + jb_2) = c_1 + jd_1$$

a. Write out this complex multiplication and determine how many real multiplies and real adds are required.

b. Show that the complex multiplication may also be performed as follows.

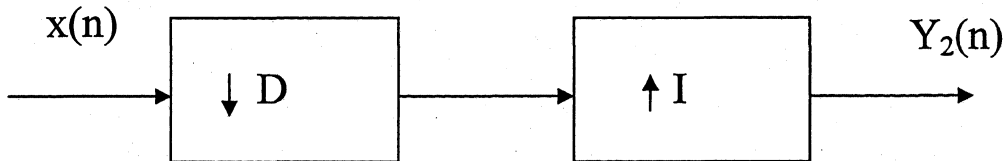
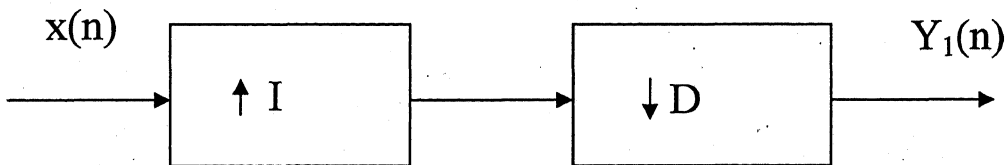
$$c_1 = (a_1 - b_1) b_2 + (a_2 - b_2) a_1$$

$$d_1 = (a_1 - b_1) b_2 + (a_2 + b_2) b_1$$

and determine the number of real multiplies and adds required with this method.

$$5+5=10$$

2. Consider two different ways of cascading a decimator with an interpolator shown below



a) If $D=I$, show that the outputs of the two configurations are different.

b) Show that the two systems are identical if and only if D and I are relatively prime.

$$10+15=25$$

3. The decimation in time and decimation in frequency FFT algorithms evaluate the DFT of a complex value sequence. Show how a N point FFT program may be used to evaluate the N point DFT of two real valued sequence simultaneously without increasing the hardware cost.

$$20$$

4. Determine the linear and circular convolution of the sequences using z-transform

$$x_1(n) = \{4, 2, 3, 1\}$$

$$x_2(n) = \{3, 4, 2, 2\}$$

$$5+10=15$$