c) Determine the 4-point DFT of the following pair of length-4 sequences in the most efficient method.

$x[n] = [1, 1, 1, 1]$ $\quad$ $g[n] = [1, 0, 0, 1]$

[6+8+6=20 marks]

Module 2

13. a) Determine the H(z) for a Butterworth filter satisfying the following constraints.

$$\sqrt{0.5} \leq |H(e^{j\omega})| \leq 1 \qquad 0 \leq \omega \leq \frac{\pi}{2}$$

$$|H(e^{j\omega})| \leq 0.2 \qquad \frac{3\pi}{4} \leq \omega \leq \pi$$

With T=1s. Apply impulse invariant transformation.

b) Illustrate the mapping from s-plane to z-plane in bilinear transformation. Why prewarping is required ?

[12+8=20 marks]

14. a) What is a linear phase filter? What conditions are to be satisfied by the impulse response of an FIR system in order to have linear phase?

b) The desired frequency response of a low pass filter is given by

$$H_d(e^{j\omega}) = e^{-j\beta\omega} \qquad |\omega| < \frac{3\pi}{4}$$

$$= 0 \qquad \frac{3\pi}{4} < |\omega| < \pi$$

Determine the frequency response of the FIR filter if Hamming window is used with N=7.

[8+12=20 marks]

Module 3

15.a) Obtain the direct form I, direct form II and parallel structure of a system described by the difference equation $y(n) = \frac{3}{4}y(n-1) - \frac{1}{8}y(n-2) + x(n) + \frac{1}{3}x(n-1)$.