B 2150

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Fifth Semester

Computer Science and Engineering

CS 331 — DIGITAL SIGNAL PROCESSING

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Sketch $y(n)$ for $-4 < n < 4$, if $y(n) = \delta(n+4) + 5\,\delta(n) + u(n-1)$.

2. Find the Z-transform of $\left(\frac{1}{2}\right)^n u(n)$.

3. Write DFT pair of equation.

4. What are the realisability conditions of transfer function?

5. Draw the basic FFT butterfly diagram.

6. Compare IIR with FIR filters.

7. Convert the number 0.21 into equivalent 6-bit fixed point number.

8. Explain the term 'warping effect'.

9. Test for time-invariance to up sampler.

10. Define Auto correlation function of $x(n)$, which is a random sequence.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Prove that the system described by,

$$y(n) - ay(n-1) = x(n)$$

is stable only when $|a| < 1$.

(ii) Test for causality, linearity and stability for the following systems.

$y(n) = x(n)\,x(n-1)$

$y(n) = \exp[x(n)]$

Or

(b) (i) Explain any three properties of Z-transform.

(ii) Find the convolution of $x(n) * h(n)$ through Z-transform method.

$$x(n) = \left(\frac{1}{2}\right)^n u(n)$$

$$h(n) = \left(\frac{1}{3}\right)^n u(n).$$

12. (a) Determine the closed from expression for frequency response $G\left(e^{jw}\right)$ of an LTI system with impulse response given by,

$$g(n) = \alpha^n, \quad 0 \le n \le M-1$$
$$= 0, \quad \text{otherwise}$$

Or

(b) Compute the DFT of each of the following

(i) $x(n) = \delta(n - n_0)$

(ii) $y(n) = x_1(n)\,x_2(n)$.

13. (a) (i) A DFT programe is available, How will you use this to compute inverse DFT.

(ii) Two real signals of $[x(n)$ and $y(n)]$ are of Length M. Find the DFT of $x(n)$ and $y(n)$ with minimum computation.

Or

(b) Design an FIR filter using rectangular window. The magnitude specification is given Fig. 1 [First 10 coefficients only].

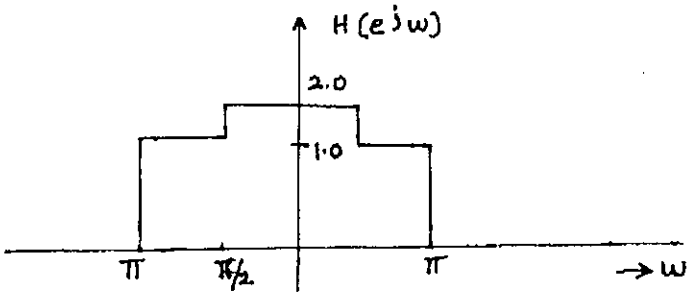

Fig. 1

14. (a) Find the structure in (i) Direct form-I (ii) Cascade form (iii) Parallel form for H (z)

$$H(z) = \frac{z^{-1} - 1}{1 - 0.5\,z^{-1} + 0.06\,z^{-2}}.$$

Or

(b) Find the transfer function; given that

$$A = \begin{bmatrix} 0.5 & 0.4 \\ -0.2 & 0.3 \end{bmatrix}; B \begin{bmatrix} 1 \\ 3 \end{bmatrix}; C = [2 \quad 3]; d = 0.4$$

Derive the formula used.

15. (a) Discuss the sampling rate conversion of rational factor (I/D).

Or

(b) (i) The input spectrum $X(e^{jw})$ is shown in Fig. 2. Draw the output spectrum if it is passed through an upsampler $(L = 2)$.

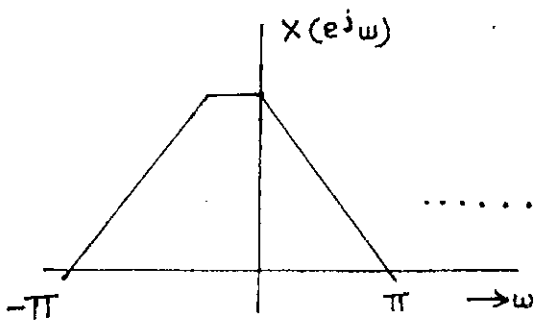

Fig. 2

(ii) A multirate system is shown in Fig. 3. Find the relation between $x(n)$ and $y(n)$.

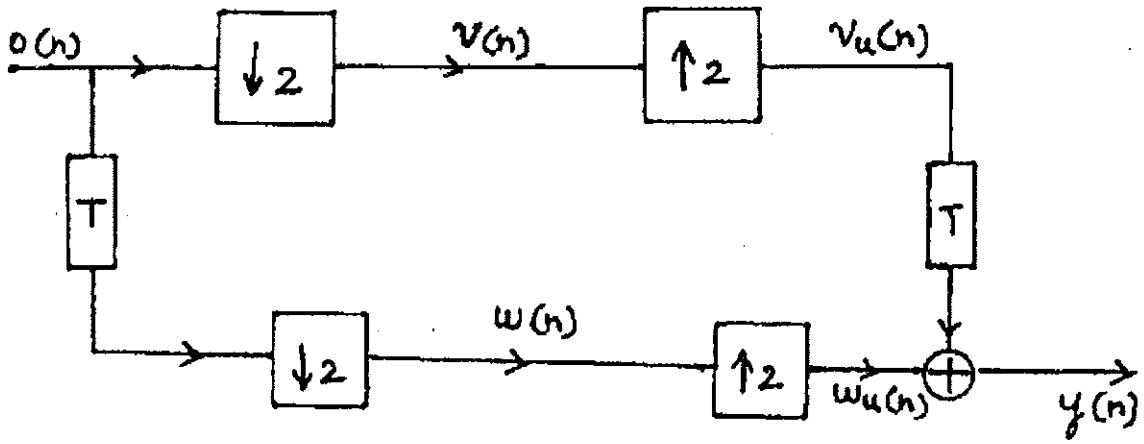

Fig. 3