

Con. 4952-07.

CD-7119

(REVISED COURSE)

( 3 Hours)

[ Total Marks : 100

- N.B. (1) Question No. 1 is compulsory.  
 (2) Attempt any four questions out of remaining six questions.  
 (3) Assume suitable data if necessary.

1. Answer the following :

(a) Derive the relationship between z-transform, DTFT and DFT. 5

(b) Determine the initial and final value of  $x(n)$  if  $X(z) = \frac{z}{2z^2 - 3z + 1}$ ,  $|z| > 1$ . 5

(c) Sketch pole-zero plot for the system with transfer function 5

$$H(z) = \frac{z^6 - 2^6}{z^5 (z - 2)}$$

is this system stable ?

(d) Find the given system is linear phase or not. Prove your answer. 5

$$h[n] = \{ 1, -2, 0, 2, -1 \}$$

2. (a) A causal DT system has transfer function

$$H(z) \text{ such that } H(z) = H_1(z) \cdot H_2(z)$$

$H_1(z)$  has one pole at  $z = 0.5$  and one zero at  $z = 1/3$ .

$H_2(z)$  has one pole at  $z = 0$  and one zero at  $z = -1/2$ .

(i) Find transfer function of system 3

(ii) Find difference equation of system. 2

(iii) Find response of system to  $i/p$  3

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

(iv) Draw pole-zero plot of the overall system and hence comment on the stability of system. 2

(b) (i) Show the condition on impulse response for a system to be BIBO stable. 5

(ii) State the convolution theorem of Z-transform. Using this property determine the convolution of following pair of signal 5

$$h_1(n) = nu(n)$$

$$h_2(n) = 2^n u(n - 1)$$

3. (a) Find the step response of a system having difference equation 6

$$Y(n) = x(n) - 0.4 y(n - 1) + 0.05 y(n - 2)$$

(b) A causal FIR system has three cascaded block, first two of them have individual impulse responses. 8

$$h_1(n) = \delta(n) + 2\delta(n - 1) + 2\delta(n - 2)$$

$$h_2(n) = u(n) - u(n - 2)$$

Find the impulse response  $h_3(n)$  of a third block, if an overall impulse response is

$$h(n) = [ 2, 5, 6, 3, 2, 2 ]$$

(c) Find the convolution and correlation of two sequences  $x_1(n)$  and  $x_2(n)$  6

$$x_1(n) = [ 2, 1, 3 ]$$

$$x_2(n) = [ -2, -1, 1 ]$$

4. (a) Let  $x(n) = \{ 1, 2, 3, 4 \}$  10
- (i) Find DFT of  $x(n)$  using DITFFT
- (ii) Let  $h(n) = \{ 1, 2, 3, 2 \}$   
Find  $y(n) = x(n) * h(n)$   
Using FFT/IFFT
- (b) If  $x(n) = \delta(n) + \delta(n - 1) + \delta(n - 2)$
- (i) Find  $X(e^{j\omega})$  3
- (ii) Find  $X(k)$ , 4 pt DFT 3
- (iii) Show that DFT is sampled version of  $|X(e^{j\omega})|$ . 4
5. (a) Determine impulse response  $h(n)$  of a linear phase FIR filter of length 4 for which 7
- $|H(\omega)|_{\omega=0} = 1$  and
- $|H(\omega)|_{\omega=\pi/2} = 1/2$
- (b) Show that zeros of a linear phase FIR filter occur at reciprocal location. 6
- (c) Show that the group delay of a linear phase FIR filter 7
- $\tau_g = \frac{N-1}{2}$
6. (a) Design a linear phase FIR filter of seventh order, with cut-off frequency 1 radian/sec. Use 8  
following window function.
- $w(n) = 0.54 - 0.46 \cos [ 2\pi n / (N - 1) ]$ ,  
 $n = 0, 1, 2, \dots, N - 1$ .
- (b) Determine the order and cut-off frequency of a butterworth low pass digital filter for 12  
following specifications :
- |                       |              |
|-----------------------|--------------|
| Pass-band attenuation | $\leq 1$ dB  |
| Stop-band attenuation | $\geq 20$ dB |
| Pass-band frequency   | $= 0.2 \pi$  |
| Stop-band frequency   | $= 0.3 \pi$  |
| Sampling frequency    | $= 5$ kHz    |
- Use (i) Impulse invariance technique  
(ii) Bilinear Transformation technique.
7. Write short notes on any **two** :— 20
- (a) Fast convolution method
- (b) DSP processor TMS320C40
- (c) Goertzel algorithm.