

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.*

*Candidates are required to give answer in their own words as far as practicable.*

**Group - A**  
**(Multiple Choice Type Questions)**

1. Choose the correct alternatives for the following: 10 x 1=10
- (i) ROC of causal finite duration discrete time signal is  
(a) the entire z plane except  $z=0$  (b) the entire z plane except  $z=\alpha$   
(c) the entire z plane (d) a ring in z plane.
- (ii) The digital system  $y(n)=x(n^2)$  is  
(a) linear and causal (b) linear and non causal  
(c) non linear and causal (d) non linear and non causal.
- (iii) If an N point sequence is  $N=16$  the total number of complex addition and multiplication using Radix-2FFT are  
(a) 64 and 80 (b) 80 and 64  
(c) 64 and 32 (d) 24 and 12.
- (iv) Convolution is used to find  
(a) impulse response of LTI system (b) frequency response of LTI system  
(c) time response of LTI system (d) phase response of LTI system.
- (v) Interpolation is a process to  
(a) reduce aliasing (b) decrease sampling rate  
(c) increase sampling rate (d) has no effect.
- (vi) Linear Phase realization structure is used to represent  
(a) FIR system (b) IIR system  
(c) both FIR and IIR system (d) all discrete time system.
- (vii) If z-transformation of a sequence  $x(n)$  is  $X(z)$  then what is the z transformation of a sequence up sample by factor L  
(a)  $X(z^{1/L})$  (b)  $X(z^L)$  (c)  $X(z^{2L})$  (d) None of these.
- (viii) IIR filters  
(a) use feedback (b) are sometime called recursive filter  
(c) can oscillate if not properly designed (d) all of above.

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- (ix) FIR filter is  
(a) recursive and linear  
(b) recursive and non linear  
(c) non recursive and linear  
(d) none of these.
- (x)  $\delta(n-k) * x(n-k)$  is equal to  
(a)  $x(k)$  (b)  $x(n-k)$  (c)  $x(n-2k)$  (d)  $\delta(n-k)$ .

Group - B

- 2.(a) Write down the property of Convolution.  
(b) What are the applications of wavelet transformation?  
(c) If a system has impulse response  $h(n) = e^{2n}u(n-1)$ , determine whether the system is stable and causal.  
(d) Obtain the convolution of following signal:  
 $X(n) = u(n)$  and  $h(n) = 2^n u(n-3)$

$$2 + 2 + 4 + 4 = 12$$

- 3.(a) Prove the Convolution property DTFT  $x_1(n) * x_2(n) = X_1(e^{j\omega}) * X_2(e^{j\omega})$ .  
(b) Find Fourier transform of the signal  $x(n) = (1/2)^{n-1}u(n-1)$   
(c) Impulse response of the system  $h(n) = 1/2\delta(n) + 1/2\delta(n-2)$ , find the frequency response  $H(\omega)$  of the system.  
(d) State the Weiner-Khintchine theorem.

$$3 + 3 + 4 + 2 = 12$$

Group - C

4. A linear time invariant system is described by the following difference equation:  
 $Y(n) = ay(n-1) + bx(n)$  where  $0 < a < 1$   
(i) Determine the impulse response  $h(n)$  of the system.  
(ii) Determine the frequency response  $H(\omega)$  of the system  
(iii) Choose the parameter  $b$  so that the maximum value of  $H(\omega)$  is unity.  
(iv) Determine the output of the system to the input signal  $x(n) = 12 \sin \pi n / 2$ .

$$(3 + 3 + 3 + 3) = 12$$

- 5.(a) State invertibility of linear time invariant system.  
(b) Determine the inverse of the system with impulse response  $h(n) = \delta(n) - \delta(n-1)$ .

(c) What is the input signal  $x(n)$  that will generate the output sequence  $y(n) = \{1, 5, 10, 11, 8, 4, 1\}$  for a system with impulse response  $h(n) = \{1, 2, 1\}$ ?

(d) What do you mean by Homomorphic deconvolution?

$$2 + 3 + 5 + 2 = 12$$

**Group - D**

6.(a) What are the advantage and disadvantage of FIR filter over IIR filter?

(b) Design a low pass FIR filter with 11 coefficients for the following specification.

Pass band frequency edge = 0.25 kHz

Sampling frequency = 1 kHz

Use Hamming window technique.

$$4 + 8 = 12$$

7.(a) What do you mean by Gibbs phenomenon?

(b) Using frequency sampling method design a band pass filter with the following specifications:

sampling frequency  $F = 8000\text{Hz}$ , cut off frequency  $f_{c1} = 1000\text{Hz}$ ,  $f_{c2} = 3000\text{Hz}$ .

Also determine the filter coefficient for  $N = 7$ .

$$4 + (5 + 3) = 12$$

**Group - E**

8.(a) Explain sampling rate conversion by a rational factor  $I/D$ .

(b) How can you design a filter for implementation of sampling rate conversion?

$$6 + 6 = 12$$

9.(a) Write down the least mean square algorithm of adaptation filter and confirm that it is  $O(M)$  algorithm.

(b) Compare the LMS algorithm with the steepest descent algorithm.

$$6 + 6 = 12$$