

Con. 5163-09.

SP-6572

(3 Hours)

[Total Marks : 100

- N.B. :** (1) Question No. 1 is **compulsory**.  
 (2) Attempt any **four** out of remaining **six** questions.  
 (3) Assume **suitable** data wherever **necessary**, justify the **same**.

1. (a) Find the even and odd parts of the signal  $x(n) = u(n)$ . 5  
 (b) Determine whether following signals are periodic, if periodic determine the fundamental period. 5  
     (i)  $x(n) = \text{Re} \{e^{jn\pi/12}\} + \text{Im} \{e^{jn\pi/18}\}$       (ii)  $x(n) = e^{j\pi/6n} \cos(n\pi/17)$   
 (c) Determine the response of the relaxed system characterized by the impulse response  $h(n) = \left(\frac{1}{2}\right)^2 u(n)$  to the input signal  $x(n) = 2^n u(n)$ . 5  
 (d) Find the Natural response of the system described by the difference equation  $y(n) + 2y(n-1) + y(n-2) = x(n) + x(n-1)$  with initial condition  $y(-1) = y(-2) = 1$ . 5
  
2. (a) Define z-transform and explain the importance of ROC. State and prove initial value theorem and final value theorem. 10  
 (b) Find the z-transform of the following sequences : 10  
     (i)  $x(n) = \left(\frac{1}{2}\right)^n u(n+2) + (3)^n u(-n-1)$       (ii)  $x(n) = \left(\frac{1}{3}\right)^n \cos(n\omega_0) u(n)$ .
  
3. (a) Explain and draw the basic network structures for IIR system. 10  
 (b) A causal linear shift invariant system is characterized by the difference equation  $y(n) = \frac{1}{4} y(n-1) + \frac{1}{8} y(n-2) + x(n) - x(n-1)$ . Find the system function,  $H(z)$  and the unit sample response,  $h(n)$ . 10
  
4. (a) Compare between circular convolution and linear convolution. Determine the output response  $y(n)$  if  $h(n) = \{1, 1, 1\}$  :  $x(n) = \{1, 2, 3, 1\}$  by using : 12  
     (i) Linear convolution  
     (ii) Circular convolution  
     (iii) Circular convolution with zero padding.  
 (b) A linear phase FIR filter has  $H_1(\omega) = \cos \frac{\omega}{2} + \frac{1}{2} \cos \frac{3\omega}{2}$ . Determine the impulse response  $h(n)$ . 8
  
5. (a) Explain the Decimation in time FFT and Decimation in Frequency FFT. Draw the Butterfly Diagram for  $N = 8$ . 15  
 (b) State and prove Parseval's Power Relation and Energy Relation. 5
  
6. (a) Design a low pass Butterworth filter that has a 3-dB cut-off frequency of 1.5 KHz and attenuation of 49 dB at 3 KHz. 10  
 (b) Explain the procedure to design Digital filters from Analog Filters using : 10  
     (i) Impulse Invariance  
     (ii) Based on Differential Equation  
     (iii) Bilinear Transformation.

7. Explain the following :-

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- (a) DSP Techniques Applied in Audio Signal Processing
  - (b) Different Generations of Digital Signal Processor
  - (c) Filter Design using Frequency Transformations
  - (d) Hilbert Transform Relations for the DFT
  - (e) Chirp z-Transform Algorithms.
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