

Obtain DFT of a sequence  $x[n] = \left\{ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}, \frac{1}{2}, 0, 0, 0, 0 \right\}$   
using decimation-in-frequency FFT algorithm.

### Unit - V

5. a) An analog filter has the following system function. Convert this filter into a digital filter using backward difference for the derivative

$$H(s) = \frac{1}{(s+0.1)^2 + 9}$$

- b) Convert the analog filter into a digital filter whose system

$$\text{function is } H(s) = \frac{s+0.2}{(s+0.2)^2 + 9}$$

Use the impulse invariant technique. Assume  $T = 1s$ .

- c) Convert the analog filter with system function

$$H(s) = \frac{s+0.1}{(s+0.1)^2 + 9}$$

into a digital IIR filter using bilinear transformation. The

digital filter should have a resonant frequency of  $\omega_r = \frac{\pi}{4}$ .

- d) Describe the Butter worth filters.

OR

Describe Chebyshev filters.

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## EC-603

### B.E. VI Semester

Examination, December 2015

### Digital Signal Processing

Time : Three Hours

Maximum Marks : 70

- Note:** i) Answer five questions. In each question part A, B, C is compulsory and D part has internal choice.  
ii) All parts of each question are to be attempted at one place.  
iii) All questions carry equal marks, out of which part A and B (Max. 50 words) carry 2 marks, part C (Max. 100 words) carry 3 marks, part D (Max. 400 words) carry 7 marks.  
iv) Except numericals, Derivation, Design and Drawing etc.

### Unit - I

1. a) Test, whether the system  $y[n] = x[n]\cos(\omega_0 n)$  is linear or nonlinear.  
b) Determine the range of values of a and b for which the L.T.I. system with impulse response  

$$h[n] = \begin{cases} a^n, & n \geq 0 \\ b^n, & n < 0 \end{cases}$$
is stable  
c) The discrete time system  $y[n] = ny[n-1] + x[n], n \geq 0$  is at rest [i.e  $y[-1] = 0$ ]. Test whether the system is L.T.I.  
d) Determine the zero input response of the system described by the 2<sup>nd</sup> order difference equation.  

$$x[n] - 3y[n-1] - 4y[n-2] = 0$$

OR

Determine the particular solution of the difference equation

$$y[n] = \frac{5}{6} y[n-1] - \frac{1}{6} y[n-2] + x[n]$$

When the forcing function is  $x[n] = 2^n u[n]$

**Unit - II**

2. a) Determine the Z-transform of the signal,

$$x[n] = \{3, 0, 0, 0, 0, 6, 1, -4\}$$

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- b) Obtain inverse Z-transform using residue method of the signal

$$X[Z] = \frac{1}{(Z-1)(Z-3)}$$

- c) Determine the response of the system characterized by impulse response  $h[n] = (0.5)^n u[n]$  to the input signal

$$x[n] = 2^n u[n]$$

- d) Determine the unit step response of the system characterized by the difference equation

$$y[n] = 0.6y[n-1] - 0.08y[n-2] + x[n]$$

OR

Find the linear convolution of  $x_1[n]$  and  $x_2[n]$  using z-transform

$$x_1[n] = \{1, 2, 3, 4\} \text{ and } x_2[n] = \{1, 2, 0, 2, 1\}$$

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**Unit - III**

3. a) Compute the DFT of the following finite length sequence of length N, (N is even)

$$x[n] = \begin{cases} 1, & 0 \leq n \leq \frac{N}{2} - 1 \\ 0, & \frac{N}{2} \leq n \leq N - 1 \end{cases}$$

- b) State and prove the linearity property of DFT.  
c) Let  $x[n]$  be a real and odd periodic signal with period  $N = 7$  and Fourier coefficients  $a_k$ . Given that  $a_{15} = j$ ,  $a_{16} = 2j$ ,  $a_{17} = 3j$ . Determine the values of  $a_0$ ,  $a_{-1}$ ,  $a_2$  and  $a_{-3}$ .  
d) Prove that the multiplication of two DFT's is equivalent to the circular convolution of their sequences in time domain.

OR

Using graphical method, obtain a 5-point circular convolution of two discrete time signals defined as:

$$x[n] = (1.5)^n u[n], \quad 0 \leq n \leq 2$$

$$y[n] = (2n-3) u[n], \quad 0 \leq n \leq 3$$

**Unit - IV**

4. a) State the computational requirements of FFT.  
b) What is decimation-in-time FFT algorithm?  
c) Explain the Goertzel algorithm.  
d) Develop a radix-3 DIT FFT algorithm for evaluating the DFT for  $N = 9$ .

OR