

**III B. Tech I Semester Regular Examinations, February-2022****DIGITAL SIGNAL PROCESSING**

(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**

All Questions Carry Equal Marks

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**UNIT-I**

1. a) i) Define the periodicity of a signal. [8M]  
ii) Determine whether the DT signal,  $x[n] = \cos\left[\left(\frac{12\pi}{5}\right)n\right]$ , is periodic or not. If yes, find its fundamental period.  
b) Find the solution for the difference equation  
 $y[n] = ay[n - 1]$   
as a function of initial condition  $y[0]$ .

**(OR)**

2. a) Show that the sufficient condition for an LTI system to be BIBO stable is  $\sum_{k=-\infty}^{\infty} |h[k]| < \infty$ . [8M]  
b) Determine the inverse z-transform of  $H(z) = \frac{z^2}{(z-0.2)(z+0.8)}$  considering that  $H(z)$  is a causal system.

**UNIT-II**

3. a) A discrete-time signal is given by  $x[n] = [-1, 1, 1, 1]$ . Find 4-point DFT of  $x[n]$ . [8M]  
b) State and prove time-shifting property of DFS. [7M]

**(OR)**

4. a) Explain how the linear convolution is computed using DFT and IDFT, with an example. [8M]  
b) Find the 8-point DFT of  $x[n] = [1, -1, 1, -1, 1, -1, 1, -1]$  using radix-2 DITFFT algorithm. [7M]

**UNIT-III**

5. a) Explain how the s-plane is mapped to z-plane in impulse invariant transformation. [7M]  
b) Explain the design procedure of analog Butterworth lowpass filter. [8M]

**1 of 2**

**(OR)**

6. a) Explain how an analog filter is transformed to a digital filter by using bilinear transformation method. [8M]  
 b) Explain how digital lowpass filter is transformed to digital highpass, bandpass and bandstop filter using frequency transformation. [7M]

**UNIT-IV**

7. a) The type-III linear-phase FIR filter is characterized by  

$$h[n] = -h[M - 1 - n], 0 \leq n \leq M - 1, M \text{ odd}$$
  
 Find the magnitude response,  $|H(\Omega)|$ . [8M]  
 b) Design a linear phase lowpass FIR digital filter using rectangular window to meet the following specifications:  $\Omega_c = 0.1\pi$  and  $L = 7$ . [7M]

**(OR)**

8. a) What do you understand by distortion-less transmission of a digital filter? Define (i) Phase delay (ii) Group delay. [8M]  
 b) Design a linear phase highpass FIR filter using frequency sampling method to meet the following specifications:  $\Omega_c = 0.25\pi$  and  $L = 9$ . [7M]

**UNIT-V**

9. a) The signal  $x[n] = [0 \ 2 \ 4 \ 6 \ 8]$  is interpolated using the interpolated filter sequence  $b_k = [0.5 \ 1 \ 0.5]$  and the interpolation factor is 2. Determine the interpolated sequence. [8M]  
 b) Give the frequency domain description of an up-sampler. [7M]

**(OR)**

10. a) Derive an expression for z-transform of output of a down-sampler. [8M]  
 b) If  $x[n] = [0 \ 2 \ 4 \ 6 \ 8 \ 1 \ 3 \ 5 \ 7 \ 9]$ , find and plot  $x_u[n] = x\left[\frac{n}{2}\right]$  and  $x_d[n] = x[3n]$ . [7M]

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