

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

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 [7M]

$$y[n] = ay[n - 1]$$
 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 $H(z) = \frac{z^2}{(z-0.2)(z+0.8)}$ [7M]
 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]



(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 [8M]

$$h[n] = -h[M - 1 - n], 0 \leq n \leq M - 1, M \text{ odd}$$
 Find the magnitude response, $|H(\Omega)|$.
 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]
