B.E. Electronics & Communication / Telecommunication Engineering (Model Curriculum)
Semester - V

ET505M - Digital Signal Processing

P. Pages : 2 **GUG/S/23/13926**

Time : Three Hours * 2 6 6 3 * Max. Marks : 80

Notes : 1. All questions carry marks as indicated.
2. Assume suitable data wherever necessary.
3. Illustrate your answers wherever necessary with the help of neat sketches.

1. a) Determine the value of power and energy of the following signals. Find whether signals are power, energy or neither power nor energy signals. **6**

i) $x(n) = (1/4)^n u(n)$ ii) $x(n) = u(n)$

b) Discuss the following classifications of discrete time signals. **4**

i) Energy and power signal ii) Symmetric and anti-asymmetric signal
iii) Periodic and non periodic signal iv) Deterministic and non deterministic signal

c) Compute the circular convolution of the following two sequences. **6**

$X_1(n) = \{4, 3, 2, 1\}$

$X_2(n) = \{1, 2, 3, 4\}$

OR

2. a) Compute the 8 point Discrete Fourier Transform of the sequence. **7**

$x(n) = \{1, 1, 1, 1, 1, 1, 0, 0\}$

b) Summarize the various applications of digital signal processing. **3**

c) Find the 8 point DFT of the sequence $X(n) = \cos\left(\frac{n\Pi}{2}\right)$ where $N = 4$ using DIF-FFT algorithm. **6**

3. a) Find the output of y(n) of the LTI-DT system given as **10**

$$y(n) - \frac{3}{2}y(n-1) + \frac{1}{2}y(n-2) = 2x(n) + \frac{3}{2}x(n-1)$$

with initial conditions given as $y(-1) = 0$, $y(-2) = 1$ and $x(-1) = 0$ with input

$$x(n) = \left(\frac{1}{4}\right)^n u(n)$$

b) Determine inverse z transform using long division method. **6**

$$x(z) = \frac{z^2 + z + 2}{z^2 - 2z^2 + 3z + 4} \text{ for ROC} |z| < 1$$

OR

4. a) With the help of property of z transform prove that **6**

$$z\left\{n^p\right\} = -z\frac{d}{dz}z\left[n^{p-1}\right]$$

where p is a positive integer and hence deduce for $z\left\{n^2\right\}$

b) State and prove the following Final value theorem property of z-transform. **4**

c) Find the z transform of **6**

i) $X(n) = a^n \cos w_0 n\, u(n)$ ii) $X(n) = n2^n \sin\left(\frac{\pi}{2} n\right) u(n)$

5. a) Obtain the direct form I, direct form II, cascade and parallel structure for the following system. **12**

$$y(n) = y(n-1) - \frac{1}{2} y(n-2) + x(n) - x(n-1) + x(n-2)$$

b) Difference between FIR and IIR filters. **4**

OR

6. a) Derive the expression for rounding and truncation errors. **6**

b) Consider a second order IIR filter with $H(z) = \frac{10}{\left(1-0.5z^{-1}\right)\left(1-0.45z^{-1}\right)}$ find the effect on quantization on pole location of the given system function in direct form and cascade form. Take b = 3 bits. **10**

7. a) Convert the analog filter with system function $H(s) = \frac{s+0.1}{(s+0.1)^2+16}$ into digital IIR filter using bilinear transformation method. The digital filter should have resonant frequency of $\omega = \frac{\pi}{2}$. **8**

b) Determine digital filter for the given analog filter using impulse invariance method. **8**

$$H(S) = \frac{S+a}{(S+a)^2 + b^2}$$

OR

8. a) Design a digital Butterworth low pass filter with specifications. **12**

$\alpha_p = 1\text{dB}$ ripple in passband $0 \le w \le 0.2\Pi$

$\alpha_s = 15\text{dB}$ in stopband $0.3\Pi \le w \le \Pi$

using bilinear transformation. Assume T = 1 sec.

b) Explain the finite word length effects in digital filter. **4**

9. Explain with an example. **16**

i) Decimation by factor D ii) Interpolation by factor I

OR

10. a) Explain Quadrature - Mirror Filter [QMF] Bank in detail. **8**

b) Explain in brief implementation of digital filter bank. **8**

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