B.E. / B.Tech. Instrumentation Engineering (Model Curriculum) Semester-VI

IN605M / DIGITAL1 - Digital Signal Processing

P. Pages : 2 **GUG/S/25/14032**

Time : Three Hours Max. Marks : 80

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Notes : 1. All questions carry marks as indicated.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Diagrams and Chemical equation should be given wherever necessary.

1. A) Define and plot following standard discrete time signals. **8**

1) Digital signal
2) Unit step signal
3) Ramp signal
4) Exponential signal
5) Discrete time sinusoidal signal
6) Discrete time complex exponential signal.

B) Test the causality of the following systems. **8**

i) y(n) = x(n) + 2x(n+3)
ii) y(n) = x(3n)

OR

2. A) Determine whether the following signals are energy or power signals. **8**

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

ii) $x(n) = u(n)$

B) Determine the even and odd part of the signals. **8**

i) $x(n) = 3e\ j/5n$

ii) $x(n) = \{2, -2, 6-2\}$

3. A) Compute 8 point DFT of the discrete – time signal, $x(n) = \{1,2,3,4,4,3,2,1\}$ using radix -2 decimation-in-time (DIT) FFT algorithm. **12**

B) Determine the Fourier transform of the following signals. **4**

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

OR

4. A) Compute 8-point DFT of the discrete – time signal, $x(n) = \{1,2,3,4,4,3,2,1\}$ using radix – 2 decimation-in-frequency (DIF) FFT algorithm. **12**

B) What is phase factor or twiddle factor? Draw and explain the basic butter fly diagram structure for- **4**

a) DIT Radix – 2 FFT
b) DIF Radix – 2 FFT.

5. A) Design a Butterworth digital IIR lowpass filter using impulse invariant transformation by taking T = 1 second, to satisfy the following specifications. **12**

$$0.707 \le \left|H\left(e^{jw}\right)\right| \le 1.0;\ \text{for}\ 0 \le w \le 0.3\pi$$

$$\left|H\left(e^{jw}\right)\right| \le 0.2;\ \text{for}\ 0.75\,\pi \le w \le \pi$$

B) Obtain H(z) from H(s) when T = 1 second and **4**

$$H(s) = \frac{2s}{s^2 + 0.2s + 1}$$

OR

6. A) Design a Chebyshev digital IIR lowpass filter using impulse invariant transformation by taking T = 1 second, to satisfy the following specifications. **12**

$$0.9 \le \left|H\left(e^{jw}\right)\right| \le 1.0;\ \text{for}\ 0 \le w \le 0.25\pi$$

$$\left|H\left(e^{jw}\right)\right| \le 0.24;\ \text{for}\ 0.5\,\pi \le w \le \pi$$

B) Sketch the ideal and practical frequency response of four basic types of analog & digital filters and mark the important filter specification. **4**

7. A) Design a linear phase FIR high pass filter using hamming window, with a cutoff frequency, $\omega_c = 0.8\pi$ rad/sample and N = 7. **12**

B) Write the procedure for designing FIR filter using windows. **4**

OR

8. A) Design a linear phase FIR band stop filter to reject frequencies in the range 0.4π to 0.65π rad/samples using rectangular window by taking 7 samples of window sequence. **12**

B) What are FIR filters? Write the steps involved in FIR filter design. **4**

9. A) Draw the direct form structure of the FIR system described by the transfer function, **10**

$$H(z) = 1 + \frac{1}{2}z^{-1} + \frac{3}{8}z^{-2} + \frac{5}{4}z^{-3} + \frac{1}{2}z^{-4} + \frac{7}{8}z^{-5}$$

B) Compare the direct form-I and II structures of an IIR system, with M zeros and N poles. **6**

OR

10. A) The transfer function of a system is given by, **10**

$$H(z) = \frac{\left(2 - z^{-1}\right)\left(1 - z^{-1}\right)^2}{\left(1 - 2z^{-1}\right)\left(5 - 3z^{-1} + 2z^{-2}\right)}$$

Realize the system in cascade and parallel structures.

B) What are the advantages of cascade and parallel realization of IIR systems? **6**

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