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

IN605M - Digital Signal Processing

P. Pages : 2 **GUG/S/23/14032**

Time : Three Hours Max. Marks : 80

* 2 7 6 9 *

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.
5. Illustrate your answers wherever necessary with the help of neat sketches.

1. a) Give the classification of discrete time systems with illustrative examples. **8**

b) Test the following systems for time invariance **8**

i) $y(n) = x(n) - bx(n-1)$

ii) $y(n) = 2nx(n)$

OR

2. a) What is sampling of continuous time signals? How discrete time signal is obtained from sampling method. Also define sampling period and sampling frequency. **8**

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 DFT of the sequence, x(n) = {0, 2, 3, –1} **4**

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

OR

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

b) How many complex multiplications and additions are involved in radix-2 FFT and direct-DFT. **4**

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) Discuss the advantages and disadvantages of digital filters. **4**

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 lowpass filter using rectangular window by taking 7 samples of window sequence and with a cutoff frequency, $\omega_c = 0.2\pi$ rad/sample. **12**

b) Write the window equation for **4**

i) Bartlett or Triangular window

ii) Hamming window.

OR

8. Determine the coefficients of a linear-phase FIR filter of length N = 15 which has a symmetric unit sample response and a frequency response that satisfies the conditions: **16**

$$H\left(\frac{2\pi k}{15}\right) = 1 \quad ; \qquad \text{for } k = 0,1,2,3$$

$$= 0.4 \; ; \qquad \text{for } k = 4$$

$$= 0 \quad ; \qquad \text{for } k = 5,6,7$$

9. a) Find the direct form-I and direct form-II realizations of a discrete time system represented by transfer function, **12**

$$H(z) = \frac{2z^3 - 4z^2 + 11z - 8}{(z-8)\left(z^2 - z + 3\right)}$$

b) Compare the direct form-I and II structures of an IIR system, with M zeros and N poles. **4**

OR

10. a) The transfer function of a system is given by, **12**

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

Realize the system in cascade and parallel structures.

b) Draw the direct form-I structure of second-order IIR system with equal number of poles and zeros. **4**

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