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

IN605M - Digital Signal Processing

P. Pages : 2 **GUG/W/24/14032**

Time : Three Hours * 5 5 7 3 * Max. Marks : 80

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. Same answer book must be used for each section.

1. a) Differentiate between analog and digital signal processing. State the advantages of digital signal processing over analog signal processing. State applications of digital signal processing. **8**

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

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

ii) $y(n) = 2n\,x(n)$

OR

2. a) Illustrate the different ways of representation of discrete time signals. **8**

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

i) $x(n) = \left(\frac{1}{2}\right)^n u(n)$

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

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

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, **12**
$x(n) = \{1, 2, 1, 2, 1, 3, 1, 3\}$ using radix-2 decimation-in-frequency (DIF) FFT algorithm.

b) Define the DFT of a discrete time sequence. Also state the advantages of DFT over DTFT. **4**

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

$$0.8 \le \left|H(e^{jw})\right| \le 1.0; \text{ for } 0 \le w \le 0.2\pi$$

$$\left|H(e^{jw})\right| \le 0.2; \text{ for } 0.32\pi \le w \le \pi$$

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 Butterworth digital IIR highpass filter using bilinear transformation by taking T=0.1 second, to satisfy the following specifications. **12**

$$0.6 \le \left|H(e^{jw})\right| \le 1.0; \text{ for } 0.7\pi \le w \le \pi$$

$$\left|H(e^{jw})\right| \le 0.1; \text{ for } 0 \le w \le 0.35\pi$$

b) What is bilinear transformation? Write the relation between digital and analog frequency in bilinear transformation. **4**

7. a) Design a linear phase FIR lowpass filter with a cutoff frequency of 0.5π rad /sample by taking 11 samples of ideal frequency response. **12**

b) Write the procedure for FIR filter design by frequency sampling method. **4**

OR

8. a) Design linear phase FIR bandpass filter to pass frequencies in the range 0.4π to 0.65π rad /sample by taking 7 samples of Hanning window sequence. **12**

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

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

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

Realize the system in cascade and parallel structures.

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

OR

10. a) Find the direct form-I and direct form-II realizations of a discrete time system represented by transfer function, **10**

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

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

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