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

IN605M - Digital Signal Processing

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

Time : Three Hours * 7 6 1 9 * Max. Marks : 80

Notes : 1. All questions carry marks as indicted.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.

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

b) Test the following systems for linearity. **8**

i) $y(n) = x(n^2)$ ii) $y(n) = Bx(n) + C$

OR

2. a) Give the classification of discrete time signals with examples. **8**

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

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

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

OR

4. a) 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**

b) Determine the Fourier transform of the following signals. **4**
$X(n) = \{-3,4,-1,2\}$.

5. a) Design a Butterworth digital IIR high pass filter using bilinear transformation by taking T=0.1 second, to satisfy the following specifications **12**

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

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

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 bilinear transformation by taking T=1 second, to satisfy the following specifications. **12**

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

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

b) What is impulse invariant transformation? Write the relation between digital and analog frequency in impulse invariant transformation. **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) What are FIR filters? Write the steps involved in FIR filter design. **4**

OR

8. a) Design a linear phase FIR bandstop 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) Write the procedure for FIR filter design by frequency sampling method. **4**

9. Obtain the direct form-I, direct form-II, cascade and parallel form realization of the LTI system governed by the equation, **16**

$$y(n) = -\frac{3}{8}\,y(n-1) + \frac{3}{32}\,y(n-2) + \frac{1}{64}\,y(n-3) + x(n) + 3x(n-1) + 2x(n-2)$$

OR

10. a) Realize the following FIR system with minimum number of multipliers. **8**

$$H(n) = \{-0.5, 0.8, -0.5\}$$

b) Draw the direct form-I structure of second-order IIR system with equal number of poles and zeros. Also compare the direct form-I and II structures of an IIR system, with M zeros and N poles. **8**

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