Reg. No. : | | | | | | | | | | | | |

Question Paper Code : X 20769

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
Fifth/Sixth Semester
Information Technology
IT 6502 – DIGITAL SIGNAL PROCESSING
(Common to : Computer Science and Engineering/Mechatronics Engineering)
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. A signal x(t) = sin (5πt) is sampled and what is the minimum sampling frequency is needed to reconstruct the signal without aliasing.
2. Find the system (transfer) function of given difference equation. Using z transform y(n) – 0.5 y(n – 1) = x (n).
3. Find the DFT of unit impulse sequence.
4. Why FFT is needed ?
5. What does "frequency warping" mean ?
6. Given the transfer function of LPF, $H(s) = \frac{1}{s+1}$, find the Transfer function of HPF having a cutoff frequency of 10 rad/sec.
7. List the properties of FIR filter.
8. Mention the desirable characteristics of the windows.
9. Compare fixed point and floating point representations.
10. Define dead band.

PART – B **(5×13=65 Marks)**

11. a) Check whether the following systems are static or dynamic, linear or non-linear, time variant or invariant, causal or non-causal ?
    i) $y(n) = x(n) + x(n-1)$ **(7)**
    ii) $y(n) = nx^2(n)$. **(6)**

    (OR)

    b) Determine the system function and impulse response of the system described by the difference equation $y(n) = 2y(n-1) - y(n-2) + x(n) + 3x(n-1)$. **(13)**

12. a) Explain different filtering methods based on DFT and FFT. **(13)**

(OR)

b) Determine the response of LTI system when input sequence x(n) = {– 1, 1, 2, 1} and impulse response h(n) = {– 1, 1, – 1, 1} by radix-2 DIT FFT. **(13)**

13. a) Compute a Chebyshev analog lowpass filter transfer function by using bilinear transformation technique for the following specification (T = 1 sec) :

$0.8 \leq |H(e^{j\omega})| \leq 1, \quad 0 \leq \omega \leq 0.2\pi$

$|H(e^{j\omega})| \leq 0.2, \quad 0.6\pi \leq \omega \leq \pi.$ **(13)**

(OR)

b) Design a Butterworth digital lowpass filter using impulse invariant technique with T = 1 sec satisfying the following specification :

$0.8 \leq |H(e^{j\omega})| \leq 1 \quad 0 \leq \omega \leq 0.25\pi$

$|H(e^{j\omega})| \leq 0.15 \quad 0.65\pi \leq \omega \leq \pi$ **(13)**

14. a) Design a HPF with the following frequency response :

$H_d(e^{j\omega}) = 1$ for $\pi/4 \leq \omega \pi$

$= 0$ for $|\omega| \leq \pi/4$

of length N = 11 using Hanning window. **(13)**

(OR)

b) Using frequency sampling method design a bandpass filter with the following specifications; sampling frequency 8 kHz, lower cutoff frequency 1000 Hz and upper cut off frequency 3000 Hz. **(13)**

15. a) Derive the steady state output noise power and find the steady state variance of the noise in the output due to quantization of input for the first order filter y(n) = ay (n – 1) + x(n). **(13)**

(OR)

b) State the need for Scaling and derive the scaling factor for a second order IIR filter. **(13)**

PART – C **(1×15=15 Marks)**

16. a) Find the 8 Point DFT of x(n) = {0, 1, 2, 3, 4, 5, 6, 7} using DIF – FFT algorithm and also sketch Magnitude and phase response. **(15)**

(OR)

b) Explain the characteristics of limit cycle oscillation represented to the system described by y(n) = 0.95 y (n – 1) + x(n). Determine the dead band of the filter. **(15)**

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