**Code: 20A04502T** **R20**

B.Tech III Year II Semester (R20) Supplementary Examinations January 2024

# DIGITAL SIGNAL PROCESSING

(Electrical & Electronics Engineering)

Time: 3 hours Max. Marks: 70

## PART – A

(Compulsory Question)

*****

1 Answer the following: (10 X 02 = 20 Marks)

| | | | |
|---|---|---|---|
| | (a) | What are the advantages of digital signal processing over analog signal processing? | 2M |
| | (b) | What is an LTI system? | 2M |
| | (c) | What are twiddle factors of the DFT? | 2M |
| | (d) | Why FFT is called so? | 2M |
| | (e) | Distinguish between Butterworth and Chebyshev (Type-I) filter. | 2M |
| | (f) | What are the different types of structures for realization of IIR systems? | 2M |
| | (g) | What are the advantages of FIR filters? | 2M |
| | (h) | List the basic structures of FIR filters. | 2M |
| | (i) | What is the need for multirate signal processing? | 2M |
| | (j) | Define Quantization. | 2M |

## PART – B

(Answer all the questions: 05 X 10 = 50 Marks)

| | | | |
|---|---|---|---|
| 2 | (a) | Define the following terms as referred to LTI discrete time system:<br>(i) Stability,<br>(ii) Causality. | 4M |
| | (b) | Determine whether the following systems are Causal or not.<br>(i) y(n) = x(n) + x(n-2),<br>(ii) y(n) = x(2n). | 6M |
| | | **OR** | |
| 3 | (a) | Determine whether the following discrete time signals are Periodic or not. If Periodic, determine the fundamental period.<br>(i) cos 2n, (ii) sin 4πn. | 5M |
| | (b) | Explain about the classification of discrete-time signals. | 5M |
| 4 | (a) | Given x(n) = {1, 1, 1, 1, 1, 1, 1, 1}, find X(k) using DIT FFT algorithm. | 5M |
| | (b) | Discuss the applications of FFT algorithms. | 5M |
| | | **OR** | |
| 5 | | Find the DFT of the following discrete time sequence x(n) = $\{1, -1, -1, -1, -1, -1, -1, 1\}$ using Radix-2 Decimation-In-Time FFT algorithm. | 10M |
| 6 | | Explain the following:<br>(i) Butterworth filters,<br>(ii) Chebyshev filters. | 10M |
| | | **OR** | |

**Contd. in Page 2**

7 Determine the order of the filter using Chebyshev approximation and H(s) for the given data $\alpha_p = 3$ dB, $\alpha_s = 16$ dB, $f_p = 1$ kHz, $f_s = 2$ kHz. 10M

8 (a) Distinguish between FIR and IIR filters. 3M

(b) Design a FIR digital filter to approximate an ideal low-pass filter with pass-band gain of unity, cut-off frequency of 850 Hz and working at a sampling frequency of $f_s$ = 5000 Hz. The length of the impulse response should be 5. Use a rectangular window. 7M

**OR**

9 Briefly explain about the different window functions used in FIR filter design. 10M

10 Explain about Quantization of filter coefficients in Digital Signal Processing. 10M

**OR**

11 With a neat sketch, explain the method for sampling rate conversion by a factor I/D. 10M

*****

Code: 20A04502T

**R20**

B.Tech III Year I Semester (R20) Regular & Supplementary Examinations January 2024

# DIGITAL SIGNAL PROCESSING

(Electronics & Communication Engineering)

Time: 3 hours | Max. Marks: 70

## PART – A

(Compulsory Question)

*****

1 Answer the following: (10 X 02 = 20 Marks)

| | | | |
|---|---|---|---|
| | (a) | Find the system transfer function of given difference equation using Z-transform y(n) - 0.5y(n-1) = x(n). | 2M |
| | (b) | Define LTI system. | 2M |
| | (c) | Compare DFT and FFT based on complexity. | 2M |
| | (d) | Mention the applications of zero padding. | 2M |
| | (e) | Define prewarping and mention its use. | 2M |
| | (f) | Write the frequency transformations from low pass to other filters. | 2M |
| | (g) | Mention the necessary and sufficient condition for the linear phase characteristic of FIR filter. | 2M |
| | (h) | Define Gibb's phenomenon. | 2M |
| | (i) | Define the term fixed point arithmetic with an example. | 2M |
| | (j) | Define decimation and interpolation. | 2M |

## PART – B

(Answer all the questions: 05 X 10 = 50 Marks)

| | | | |
|---|---|---|---|
| 2 | | Determine magnitude and phase response for the system described by the difference equation: $y[n] = \frac{1}{2}x[n] + x[n-1] + \frac{1}{2}x[n-2]$. Sketch the plots. | 10M |
| | | **OR** | |
| 3 | (a) | Find impulse response of the system described by the difference equation y[n] + y[n-1] - 2y[n-2] = x[n-1] + 2x[n-2]. | 5M |
| | (b) | For each of the following system, determine whether or not the system is static/dynamic, linear/non-linear, time variant/invariant, and causal/noncausal, stable/unstable. y(n) = cos[x(n)] | 5M |
| 4 | | Compute 8-point DFT of the sequence x(n) = {1, 2, 1, 2, 1, 2, 2, 1} using radix-2 DIF-FFT algorithm. | 10M |
| | | **OR** | |
| 5 | (a) | Find the 8-point DFT of the sequence x(n) = {1, 2, 1, 0, 2, 3, 0, 1} | 6M |
| | (b) | Determine the circular convolution for the two sequences $x_1(n)$ = {1, 2, 3 ,4}, $x_2(n)$= {1, 5, 1, 3}. | 4M |
| 6 | (a) | The analog transfer function H(s) = 2/(s+1)(s+2). Determine H(z) using impulse invariance method. | 5M |
| | (b) | Realize the following system with difference equation in cascade form. y(n) = y (n - 1) + 2y(n - 2) + x(n) - x(n-1). | 5M |
| | | **OR** | |

**Contd. in Page 2**

| | | | |
|---|---|---|---|
| 7 | | Design a digital Butterworth filter satisfying the following specifications<br>$0.7 \le \|H(e^{jw})\| \le 1,\ 0 \le \omega \le 0.2\pi$<br>$\|H(e^{jw})\| \le 0.2,\ 0.6\pi \le \omega \le \pi$ with T = 1 sec .<br>Determine system function H(z) for a Butter worth filter using bilinear transformation method. | 10M |
| 8 | | Design an ideal HPF with desired frequency response<br>$H_d(e^{jw}) = 1,\ \pi/4 \le \|w\| \le \pi$<br>$= 0,\ \|w\| \le \pi/4$<br>Find the values of h(n) for N = 11 and also find H(Z) using Hanning window technique. | 10M |
| | | **OR** | |
| 9 | (a) | Realize FIR filter with system function in cascade form.<br>$H(z) = 1 + 5/2z^{-1} + 2z^{-2} + 2z^{-3}$ | 5M |
| | (b) | Prove that an FIR filter has linear phase if the unit sample response satisfies the condition $h(n) = \pm h(M-1-n)$, n = 0, 1,….. M-1. Also, discuss symmetric and anti symmetric cases of FIR filter. | 5M |
| 10 | | Explain the concept of decimation by a factor D and interpolation by factor I. | 10M |
| | | **OR** | |
| 11 | | Explain the characteristics of limit cycle oscillation with respect to the system described by the difference equation:<br>$y(n) = 0.95\, y(n-1) + x(n)$<br>$x(n) = 0$; and $y(-1) = 13$<br>Determine the dead band range of the system. | 10M |

*****