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Question Paper Code : 86574

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fifth Semester

Electrical and Electronics Engineering

EC 1307 — DIGITAL SIGNAL PROCESSING

(Common to Electronics and Instrumentation Engineering and Instrumentation and Control Engineering)

(Regulations 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define LTI system.

2. What is meant by Nyquist rate?

3. What are the properties of ROC?

4. List the applications of discrete systems.

5. What is meant by radix 2 FFT?

6. Define circular convolution.

7. What is frequency warping?

8. Define phase delay and group delay.

9. What are the two types of quantization employed in digital system?

10. Sketch the noise probability density functions for rounding?

PART B — (5 × 16 = 80 marks)

11. (a) Verify and explain whether the following impulse responses describe causal, stable or LTI systems.

(i) $h(n) = e^{-0.6n}u(n)$ (4)

(ii) $h(n) = e^{n}\sin(n)u(n)$. (4)

(iii) $h(n) = 2\{\delta(n-2) + 0.5\delta(n-4)\}$. (4)

(iv) $h(n) = \begin{cases} \cos\left(\dfrac{n\pi}{8}\right), & -1 < n < 15 \\ 0, & \text{otherwise} \end{cases}$. (4)

Or

(b) (i) Explain how sampling can be done with an impulse function. Draw the spectrum of the sampled signal and explain aliasing. (8)

(ii) Explain the process of reconstruction of the signal from its samples. Obtain the impulse response of an ideal reconstruction filter. (8)

12. (a) (i) Find the inverse Z-transform of

$$X(Z) = \frac{1}{1 - 1.5^{-1} + 0.5Z^{-2}}$$

if (1) $ROC : |Z| > 1$, (2) ROC : $|Z| < 0.5$, (3) BOC : $0.5 < |Z| < 1$. (10)

(ii) Find the Z-Transform of a causal and anti-causal signal, and comment on their ROC. (6)

Or

(b) Find the Discrete Time Fourier Transform of

(i) $x(n) = a^{|n|}, -1 < a < 1$ (8)

(ii) $x(n) = \begin{cases} A, & -M \le n \le M \\ 0, & \text{otherwise} \end{cases}$ (8)

13. (a) Derive the DFT for the sequences {1, 1, 2, 2, 3, 3} and compute the corresponding amplitude and phase spectrum. (16)

Or

(b) (i) List and prove the differentiation and convolution properties of DFT. (8)

(ii) Discuss in detail butterfly operation in DIT and DIF algorithm. (8)

14. (a) (i) Explain the properties of Chebychev filters. (6)

(ii) Find the order N and the transfer function of analog Chebychev low pass filter for the following specification : Pass band ripple 3 dB and passband cut off frequency 1KHz, stopband attenuation of 16 dB at stopband frequency of 2 KHz. (10)

Or

(b) (i) Mention the characteristic features of FIR filters. (6)

(ii) Design a FIR filter with $H_d\left(e^{j\omega}\right) = \begin{cases} e^{-j3\omega,} & -\frac{\pi}{4} \le \omega \le \frac{\pi}{4} \\ 0, & \frac{\pi}{4} \le |\omega| \le \pi \end{cases}$

Using Hanning window and $N = 7$. (10)

15. (a) In the IIR system given below the products are rounded to 4-bits (including sign bit) $H(z) = 1/\left(1 - 0.35z^{-1}\right)\left(1 - 0.62x^{-1}\right)$. Find the output roundoff noise power in

(i) Direct form realization (8)

(ii) Cascade realization. (8)

Or

(b) With relevant diagrams explain the architecture and features of TMS320C54X signal processing chip.

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